

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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Title: SECONDARY LITHIUM ION CELL OR BATTERY, AND
PROTECTING CIRCUIT, ELECTRONIC DEVICE, AND
CHARGING DEVICE OF THE SAME

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**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT
NO. 7,749,641 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42**

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	REQUIREMENTS FOR IPR	2
	A. Grounds for Standing.....	2
III.	SUMMARY OF THE '641 PATENT	2
	A. Brief Description.....	2
	B. Prosecution History.....	2
	C. Level of Ordinary Skill in the Art.....	4
	D. Claim Construction	4
IV.	THE CHALLENGED CLAIMS ARE UNPATENTABLE.....	5
	A. Asserted Grounds and References	5
	B. [GROUND 1A] – CLAIMS 5-8 AND 11-14 ARE OBVIOUS OVER YAMAKI AND SAKAMOTO.....	6
	1. Yamaki describes a lithium secondary battery with high charge cutoff voltage and good cycle life	6
	2. Sakamoto describes a lithium secondary battery in which positive and negative electrode active materials are provided according to a specified range of capacity balances	8
	3. Yamaki-Sakamoto combination.....	9
	4. Reasons for the combination	11
	5. Analysis	15
	C. [GROUND 1B] – CLAIMS 9-10 ARE OBVIOUS OVER YAMAKI, SAKAMOTO, AND ABRAHAM.....	31
	1. Abraham describes electrolyte additives for overcharge protection	31
	2. Yamaki-Sakamoto-Abraham combination.....	32
	3. Reasons for the combination	33
	4. Analysis	36
	D. [GROUND 2A] – CLAIMS 5-14 ARE OBVIOUS OVER YASUNAMI AND KOYAMA.....	39
	1. Yasunami describes a lithium battery having a high end-of-charge voltage	39

2.	Koyama describes a lithium secondary battery in which positive and negative electrode active materials are provided according to a specified range of capacity ratios	40
3.	Yasunami-Koyama combination	41
4.	Reasons for the combination	43
5.	Analysis	47
E.	[GROUND 2B] – CLAIMS 9-10 ARE OBVIOUS OVER YASUNAMI, KOYAMA, AND RICHARDSON.....	63
1.	Richardson describes electrolyte additives for overcharge protection.....	63
2.	Yasunami-Koyama-Richardson combination	64
3.	Reasons for the combination	65
4.	Analysis	67
V.	PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION.....	69
A.	§314(a)	69
B.	§325(d).....	70
VI.	PAYMENT OF FEES – 37 C.F.R. § 42.103	72
VII.	CONCLUSION.....	73
VIII.	MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1).....	73
A.	Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1).....	73
B.	Related Matters Under 37 C.F.R. § 42.8(b)(2)	73
C.	Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3).....	74
D.	Service Information	74

LIST OF EXHIBITS

APPLE-1001	U.S. Patent No. 7,749,641 (“the ’641 Patent”)
APPLE-1002	Excerpts from Prosecution History of the ’641 Patent (“the Prosecution History”)
APPLE-1003	Declaration of Mr. Louis Hruska
APPLE-1004	Japanese Patent Publication No. 2001-167763 (“Yamaki”) (with certified translation)
APPLE-1005	Japanese Patent Publication No. H09-293536 (“Sakamoto”) (with certified translation)
APPLE-1006	Japanese Patent Publication No. H07-122298 (“Yasunami”) (with certified translation)
APPLE-1007	Japanese Patent Publication No. JP2000260472A (“Koyama”) (with certified translation)
APPLE-1008	PCT Publication No. WO 01/29920 (“Richardson”)
APPLE-1009	U.S. Patent No. 5,858,573 (“Abraham”)
APPLE-1010	Reserved
APPLE-1011	Reserved
APPLE-1012	“High-voltage lithium cathode materials” Hiroo Kawai, Mikito Nagata, Hisashi Tukamoto, Anthony R. West. Journal of Power Sources 81-82 (1999) 67-72 (“Kawai”)
APPLE-1013	Reserved
APPLE-1014	“Effect of Li ₂ CO ₃ additive on gas generation in lithium-ion batteries.” Jee-Sun Shin, Chi-Hwan Han, Un-Ho Jung, Shung-Ik Lee, Hyeong-Jin Kim, Keon Kim. Journal of Power Sources 109 (2002) 47-52 (“Shin”)
APPLE-1015	David Linden. Handbook of Batteries, Second ed. McGraw-Hill, Inc., 1995 (excerpts). (“Handbook”)

APPLE-1016	U.S. Patent No. 5,192,629 (“Guyomard”)
APPLE-1017	U.S. Patent No. 6,280,881 (“Wendsjo”)
APPLE-1018	U.S. Patent Pub. No. 2002/0012830 (“Uemura”)
APPLE-1019	U.S. Patent No. 6,506,518 (“Kobayashi”)
APPLE-1020	“Mathematical Modeling of the Lithium Deposition Overcharge Reaction in Lithium-Ion Batteries Using Carbon-Based Negative Electrodes.” Pankaj Arora, Marc Doyle, Ralph E. White. Journal of the Electrochemical Society 146 (10) 3543-3553 (“Arora”)
APPLE-1021	Japanese Patent Publication No. JPH0562712 (“Satoshi”)
APPLE-1022	Japanese Patent Publication No. JPH10172608 (“Ijiri”)
APPLE-1023	U.S. Patent No. 5,487,960 (“Tanaka”)
APPLE-1024	U.S. Patent No. 6,372,387 (“Kawakami”)
APPLE-1025	U.S. Patent No. 5,587,133 (“Amatucci”)
APPLE-1026	U.S. Patent No. 5,278,000 (“Huang”)
APPLE-1027	European Patent Specification EP 0 746 050 B1 (“Shimizu”)
APPLE-1028	U.S. Patent No. 6,172,482 (“Eguchi”)
APPLE-1029	U.S. Patent No. 6,577,105 (“Iwaizono”)
APPLE-1030	U.S. Patent No. 5,763,119 (“Adachi”)
APPLE-1031	<i>RJ Technology, LLC v. Apple Inc.</i> , Order Regarding Claim Construction, 8:22-CV-01874-JVS (JDEx), Document 82, August 2, 2023

Limitation	Claim Language
[5pre]	A secondary lithium ion cell or battery, characterized in that
[5a]	the secondary lithium ion cell or battery has a charge cut-off voltage of greater than 4.2V 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, 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 4.35V, 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]	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]	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.

Limitation	Claim Language
[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.

I. INTRODUCTION

Apple Inc. (“Petitioner”) petitions for IPR of claims 5-14 (“Challenged Claims”) of U.S. Patent No. 7,749,641 (“the ’641 Patent”). The Challenged Claims should be canceled as unpatentable as they are merely directed to well-known aspects of lithium battery technology.

The ’641 Patent proclaims development of batteries having a purportedly unique combination of features: operation within a particular range of charge cut-off voltages, and incorporation of positive and negative electrode materials in amounts satisfying a particular range of ratios. In fact, the ’641 Patent was granted responsive to an argument that one of ordinary skill would not have modified a battery having the claimed ratio of electrode materials such that it would operate at the claimed charge cut-off voltage range due to supposed disadvantages attributed to such voltages. But as demonstrated here, batteries were successfully operated at such voltages before the Critical Date—and importantly, such operation was not deterred by alleged disadvantages. Thus, as shown here, batteries having a combination of the claimed voltage and material ratio were known to be desirable and obvious for many reasons.

II. REQUIREMENTS FOR IPR

A. Grounds for Standing

Petitioner certifies that the '641 Patent is available for IPR. Petitioner is not barred or estopped from requesting this review.

III. SUMMARY OF THE '641 PATENT

A. Brief Description

The '641 Patent, relating to secondary lithium ion batteries, states that “the inventor unexpectedly found that the efficacy of electrode active material is greatly increased by increasing the charge cut-off voltage and property [sic] adjusting the ratio of positive electrode material to negative electrode material.” APPLE-1001, 3:3-12. Yet the claims of the '641 Patent merely recite what was already well-known: a battery having a charge cut-off voltage and a ratio of positive to negative electrode material in certain respective ranges. APPLE-1003, ¶12. And although the '641 Patent asserts that these features lead to desirable, and unexpected, performance characteristics, its experimental results fail to demonstrate that the recited ranges are in any way critical to battery performance. APPLE-1003, ¶12.

B. Prosecution History

After an anticipation rejection over Idota (US5260148), the claims were rejected over Idota in view of Tanaka (US5487960) or Kobayashi (US6558848). *See* APPLE-1002, 152, 102-105. The Examiner acknowledged that Idota did not

disclose the claimed charge cut-off voltage but proposed to “*utilize cut-off voltage as taught by Tanaka [or Kobayashi] in the battery of Idota.*” *Id.*, 103-104.

In response, despite the teaching of Tanaka and Kobayashi, Applicant argued “that charging a secondary lithium ion battery above 4.2V would cause electrolyte breakdown, reduced recycle properties, and/or structural changes in the electrode materials,” and that “the skilled artisan would not have combined Idota with Tanaka or Kobayashi because of an expectation...that the resulting battery would display inferior capacity and/or cycleability.” *Id.*, 84. Indeed, Applicant argued that “the hypothesized result would have been a lithium ion battery with very poor cycleability,” which is not “a ‘secondary’ type cell.” *Id.*, 85.

Alternatively, Applicant argued that “a battery of the claimed invention can sustain normal operation under a charge cut-off voltage greater than 4.2V,” which “would not have been expected in view of Idota and Tanaka.” *Id.*

Reasons for allowance acknowledged Applicant’s argument that because the cited art “teaches that life cycle property of a cell drastically decreases when the charging voltage increases beyond 4.2V..., one of ordinary skill...would not have predicted that the resulting cell would have high capacity.” *Id.*, 23-24.

However, as demonstrated by each of Yamaki and Yasunami, POSITAs understood that secondary lithium batteries with charge cut-off voltages greater than 4.2V were both functional and advantageous, *e.g.*, in terms of capacity and

cycleability. *See* §§IV.B.1-4, IV.D.1-4; *see also* [5a] in Grounds 1A-2A, *infra*.

Given the additional recognized advantages of batteries having a ratio of positive to negative electrode material within the claimed range, this petition demonstrates that a POSITA would have found it obvious to modify batteries with such charge cut-off voltages to have electrode materials in amounts satisfying the claimed range of ratios.

C. Level of Ordinary Skill in the Art

A person of ordinary skill in the art relating to the subject matter of the '641 Patent as of September 28, 2001 ("POSITA") would have held a Bachelor's degree in chemistry or chemical engineering, with at least 4 years of experience in cell design, electrochemical techniques, and battery materials development. A Master's Degree can substituted for some of the relevant experience. Equivalent training with battery specific experience can accommodate other degreed fields.

D. Claim Construction

Petitioner submits that all claim terms should be construed according to the *Phillips* standard. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); 37 C.F.R. § 42.100. Unless otherwise noted, terms should be given their plain meaning, but Petitioner reserves the right to respond to any constructions offered by Patent Owner or the Board.

Several terms have been construed by the Court in the co-pending district

court proceeding. *See* APPLE-1031. To the extent any construction is needed, the prior art meets the Court’s constructions, as well as Apple’s proposed constructions. In this Petition, based on the prior art’s description of the claimed elements, no formal claim constructions are necessary because “claim terms need only be construed to the extent necessary to resolve the controversy.” *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011).

IV. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Asserted Grounds and References

The Challenged Claims are invalid over the grounds identified below, as explained here and supported in the Declaration of Louis Hruska. APPLE-1003, ¶¶1-276. Hruska has extensive experience in electrochemical energy storage, including fundamental research, design, testing and manufacturing of battery cells and systems, and specifically including cell design and process development for lithium cell manufacturing.

Ground	Claims	Basis for Rejection
1A	5-8, 11-14	§103: Yamaki, Sakamoto
1B	9-10	§103: Yamaki, Sakamoto, Abraham
2A	5-14	§103: Yasunami, Koyama
2B	9-10	§103: Yasunami, Koyama, Richardson

Each applied reference pre-dates September 28, 2001 (“Critical Date”), which is the earliest filed application from which the ’641 Patent claims priority.

Without conceding the '641 Patent is entitled priority to the Critical Date, Petitioner has applied references that pre-date the Critical Date and qualify as prior art:

Reference	Date	Section
Yamaki	6/22/2001 (published)	§102(a)
Sakamoto	11/11/1997 (published)	§102(b)
Abraham	1/12/1999 (patented)	§102(b)
Yasunami	5/12/1995 (published)	§102(b)
Koyama	9/22/2000 (published)	§102(b)
Richardson	4/26/2001 (published)	§102(a)

B. [GROUND 1A] – CLAIMS 5-8 AND 11-14 ARE OBVIOUS OVER YAMAKI AND SAKAMOTO

The sections below provide a brief introduction to Yamaki, Sakamoto, and their combination.¹

1. Yamaki describes a lithium secondary battery with high charge cutoff voltage and good cycle life

Yamaki describes a “lithium secondary battery with high energy density and excellent cycle characteristics.” APPLE-1004, Abstract; APPLE-1003, ¶13.

¹ This discussion is incorporated into Grounds 1A-1B.

Yamaki's electrode compositions improve "the discharge capacity of the positive electrode active material...by setting the maximum potential of the positive electrode during charging to **4.4 V or more.**" APPLE-1004, [0014]-[0015].² Yamaki explains that "[a]s a result [of reaching this maximum potential], ***the amount of positive electrode active material in the battery can be reduced,*** and ***the amount of negative electrode active material can be increased,***" allowing "a lithium secondary battery with higher energy density [to] be obtained," "while also suppressing deterioration in the reversibility of charging and discharging." *Id.*, [0014]-[0015]; APPLE-1003, ¶19.

Yamaki's battery includes "a Co-based oxide to be used as the positive electrode active material and a conductive material to be used in the positive electrode." APPLE-1004, [0012]; *see* [0014], [0024], Abstract. With this composition, "the maximum potential of the positive electrode during charging can be from 4.4 V to 4.8 V." APPLE-1004, [0014]. This composition "suppress[es] deterioration in the reversibility of charging and discharging due to a phase transition occurring in the Co-based oxide." *Id.*, [0018]; *see* [0006], [0008], [0013], [0019], [0024]. The negative electrode is "a carbon material or a material capable of intercalating Li or forming a compound." APPLE-1004, [0030]; *see*

² Emphasis added by Petitioner except where otherwise noted.

[0031]; APPLE-1003, ¶¶14-18. Yamaki's experimental results demonstrate 93-98% capacity retention after 10 cycles in such batteries when charged to 4.5V. *See* APPLE-1004, [0028], [0056]-[0057]; APPLE-1003, ¶20.

Notably, operation of Yamaki's battery at a 4.4V-4.8V maximum potential enables the amount of positive electrode active material in the battery to be reduced and the amount of negative electrode active material to be increased. *See* APPLE-1004, [0014]-[0015]; APPLE-1003, ¶19.

2. Sakamoto describes a lithium secondary battery in which positive and negative electrode active materials are provided according to a specified range of capacity balances

Like Yamaki, Sakamoto describes a lithium secondary battery "with excellent charge-discharge cycle performance." APPLE-1005, [0001]; APPLE-1003, ¶21.

Sakamoto explains that in existing lithium secondary batteries, if "the reversible capacities on the positive electrode side and the negative electrode side are substantially equal, the charge cycle performance is insufficient due to significant deterioration from charging and discharging" and due to "deposit of lithium...on the negative electrode," noting that "the reversible capacity balance between the negative electrode and the positive electrode has a big impact on these problems." APPLE-1005, [0006]; APPLE-1003, ¶22.

Sakamoto aims to avoid these challenges by designing batteries where “[t]he reversible capacities of the positive electrode and the negative electrode...satisfy the range of $1.05 < \text{negative electrode/positive electrode} \leq 1.30$.” APPLE-1005, [0012]. Such batteries exhibit “low cycle deterioration.” *Id.*; APPLE-1003, ¶¶23-25. Sakamoto’s experimental data demonstrate that “a difference in capacity retention...depending on the reversible capacity balance.” APPLE-1005, [0015]-[0016]; APPLE-1003, ¶¶26-27.

Sakamoto does not limit applicability of its proposed approach, and when describing conventional batteries that are improved by its teachings, identifies batteries consistent with the composition and design objectives of Yamaki’s batteries. *See* APPLE-1005, [0017]; §IV.B.4, *infra*; APPLE-1003, ¶28.

3. Yamaki-Sakamoto combination

In Yamaki-Sakamoto, a lithium secondary cell based on Yamaki includes positive and negative electrode active materials in amounts that satisfy a reversible capacity balance based on Sakamoto. APPLE-1003, ¶¶29-35.

The composition of the electrodes and electrolyte of the combination battery is based on Yamaki: the combination battery includes “a positive electrode containing a Co-based oxide including Li and Co as a positive electrode active material” and “a conductive material whose main component is carbon,” while the negative electrode active material is “a carbon material.” APPLE-1004, [0013],

[0030], [0033]; APPLE-1003, ¶¶30-33. Notably, these compositions, based on Yamaki, are consistent with compositions of Sakamoto's battery. *See* APPLE-1005, [0012]-[0013], [0015]; APPLE-1003, ¶¶30-33.

As taught by Yamaki, the combination battery operates with “a maximum potential of the positive electrode during charging...from 4.4 V to 4.8 V.”

APPLE-1004, [0014]; APPLE-1003, ¶34. The presence of the additional elements in the Co-based oxide of the positive electrode “suppress[es] deterioration in the reversibility of charging and discharging,” while the carbon-containing conductive material “suppress[es] the oxidative decomposition of the organic electrolyte.”

APPLE-1004, [0018], [0024]; APPLE-1003, ¶34.

The amounts of positive and negative electrode active material in the combination battery are set based on Sakamoto such that “[t]he reversible capacities of the positive electrode and the negative electrode” are in “the range of $1.05 < \text{negative electrode/positive electrode} \leq 1.30$.” APPLE-1005, Abstract; APPLE-1003, ¶35. This ratio—more negative electrode capacity than positive electrode capacity—is enabled by “setting the maximum potential of the positive electrode during charging to 4.4 V or more,” which, as taught by Yamaki, allows “the amount of negative electrode active material [to] be increased.” APPLE-1004, [0015]; APPLE-1003, ¶35. By providing the positive and negative electrode active materials in amounts based on Sakamoto's capacity balance, the “charge-

discharge cycle performance” of the combination battery is further improved, and safety is enhanced. APPLE-1005, Abstract; *see* [0008]; APPLE-1003, ¶35.

4. Reasons for the combination

A POSITA would have been motivated to implement the Yamaki-Sakamoto combination for various reasons. APPLE-1003, ¶¶36-46.

First, a POSITA would have been motivated to pursue improved “cycle performance” offered by batteries having the materials ratio described by Sakamoto, particularly given Yamaki’s indication that such a ratio is appropriate. APPLE-1005, [0017]; *see* APPLE-1004, [0015]; APPLE-1003, ¶¶37-40. Sakamoto describes that in batteries having a capacity balance between 1.05-1.30, “deposition of lithium is less likely to occur,” and thus “less deterioration [occurs] after repeated charging and discharging” APPLE-1005, [0007]; *see* [0008], [0012], Abstract, [0006]. Consistent with Yamaki’s similar objective—providing “a lithium secondary battery with...excellent cycle characteristics”—a POSITA would have been motivated to improve further the cycle characteristics, and to do so would have adjusted the capacity balance of the electrodes based on Sakamoto. APPLE-1004, Abstract; *see* [0001], [0012]-[0018], [0059]-[0060]; APPLE-1021, [0011]; APPLE-1019, 3:24-28; APPLE-1018, [0033]; APPLE-1003, ¶¶37-40.

Second, a POSITA would have been motivated to pursue this implementation because batteries having a capacity balance such as Sakamoto’s

are “safer,” *e.g.*, “due to low risk of heat being generated and an explosion occurring,” again encouraged by Yamaki’s teaching that such a ratio is appropriate. APPLE-1005, [0007], [0008]; *see* [0017]; APPLE-1004, [0015]; APPLE-1020, 5; APPLE-1022, [000], [0017]; APPLE-1018, [0033]; APPLE-1003, ¶¶41-42.

Third, a POSITA would have been motivated to obtain a battery having “[r]esistance to overcharging,” which is achievable with batteries satisfying Sakamoto’s capacity balance. APPLE-1005, [0017]; *see* APPLE-1004, [0015]; APPLE-1003, ¶¶43-44.

Fourth, an increase in the amount of negative electrode active material is suitable for Yamaki’s battery: in a battery implementing a “maximum potential” of 4.4-4.8V, Yamaki explains that “the amount of positive electrode active material in the battery can be reduced, and *the amount of negative electrode active material can be increased.*” APPLE-1004, [0014]-[0015]; APPLE-1003, ¶45. Absent specifics from Yamaki regarding the magnitude of this increase, a POSITA would have looked to Sakamoto—which describes a battery composition consistent with that of Yamaki’s battery—for implementation details. APPLE-1003, ¶45. For instance, a POSITA implementing Yamaki’s battery would have explored known ratios of positive/negative electrode active materials, such as those described by Sakamoto, following Yamaki’s general guidance to increase the amount of

negative material. *See* APPLE-1004, [0015]; APPLE-1005, [0012]; APPLE-1003, ¶45.

Fifth, a POSITA would have been prompted to pursue this implementation because doing so is merely the application of known techniques (*e.g.*, a secondary lithium battery having more negative electrode capacity than positive electrode capacity) by a known system (*e.g.*, Yamaki’s battery, which does not promote an alternative ratio) to yield predictable results (*e.g.*, a secondary lithium ion battery having positive/negative electrode active material in amounts to provide a specific, and known, capacity balance). APPLE-1003, ¶46; *see KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007). Indeed, the ’641 Patent itself acknowledges that its charge cut-off voltage applies to conventional batteries “prepared according to the method of the prior art.” APPLE-1001, 7:51-56; *see* 1:24-28, 8:37-55.

A POSITA would have expected success in pursuing this combination for various reasons. APPLE-1003, ¶¶47-55.

First, a POSITA would have expected success because Yamaki suggests increasing the relative amount of negative electrode active material in its battery, and indeed, does so specifically in the context of a “maximum potential” of 4.4-4.8V. APPLE-1004, [0014]-[0015]; APPLE-1003, ¶48.

Second, a POSITA would have expected success because Sakamoto promotes, through the integrated ratio, Yamaki’s objective of improving cycle life.

See APPLE-1004, Abstract, [0001], [0012]-[0018], [0059]-[0060]; APPLE-1005, [0017], [0006]-[0008], [0012]; APPLE-1003, ¶49.

Third, a POSITA would have expected success because both Yamaki and Sakamoto describe secondary lithium ion batteries with similar materials systems, as detailed by Hruska. APPLE-1003, ¶¶50-54; *see* APPLE-1004, Abstract, [0016], [0013], [0018], [0020]-[0023], [0030], [0033]; APPLE-1005, [0012]-[0013], [0015]. And as noted *supra*, neither Yamaki nor Sakamoto provides any indication that the features of their respective batteries would not be suitable for integration by the other. APPLE-1003, ¶54. Indeed, Yamaki even indicates the suitability of providing more negative electrode material capacity than positive, consistent with Sakamoto's implementation. *See* APPLE-1004, [0014]; APPLE-1005, [0012]; APPLE-1003, ¶54.

Fourth, a POSITA would have expected success because secondary lithium ion batteries were known to operate with a charge cut-off voltage of greater than 4.2V and were known to have more negative than positive electrode capacity, and disclosures of each were commonly described, as in Yamaki and Sakamoto, without precluding the other. *See* APPLE-1007, [0006]; APPLE-1012, 1; APPLE-1020, 5; APPLE-1021, [0011]; APPLE-1023, 1:25-35; APPLE-1024, 40:3-14; APPLE-1025, 2:63-3:3; APPLE-1003, ¶55.

5. Analysis

(i) Claim 5

[5pre]

To the extent the preamble is deemed to be limiting, Yamaki-Sakamoto renders it obvious. APPLE-1003, ¶¶56-59.

The combination battery is a **lithium secondary battery**, *e.g.*, based on Yamaki's "***lithium secondary battery***." APPLE-1004, Abstract; *see* [0001], [0012]-[0013], [0015], [0017], [0028], [0043]-[0048], [0060], claim 1. APPLE-1003, ¶57. It is also a **lithium ion battery** at least because lithium ions are charge carriers during charging/discharging cycles. *See* APPLE-1004, [0030], [0033]; APPLE-1003, ¶¶58-59.

[5a]

In the combination, Yamaki describes that "***the maximum potential of the positive electrode during charging can be from 4.4 V to 4.8 V***." APPLE-1004, [0014]; *see* [0015]-[0017], [0028], [0052]-[0054], [0057]; §§IV.B.1, 3, *supra*; APPLE-1003, ¶60. This "maximum potential of the positive electrode" is the **charge cut-off voltage** of the combination battery at least because it is the maximum voltage to which the battery is configured to be charged, *e.g.*, the voltage at which the charging changes from constant current to constant voltage charging. APPLE-1004, [0014]; APPLE-1003, ¶¶60-68.

Yamaki describes that “[t]he maximum potential of the positive electrode during charging corresponds to *the potential in* constant voltage charging or *constant current charging* normally required to bring the secondary battery to a fully charged state.” APPLE-1004, [0017]. In constant current charging, a battery is charged at constant current until reaching its charge cut-off voltage (*e.g.*, the maximum potential of the combination battery); charging then is stopped or changes to constant voltage charging to complete charging without further voltage increase. APPLE-1003, ¶¶61-62. That is, in constant current charging, the battery is not charged to a voltage greater than its charge cut-off voltage, and thus Yamaki’s “maximum potential” is the combination battery’s **charge cut-off voltage**. APPLE-1004, [0014]; APPLE-1003, ¶64.

More specifically, given advantages (explained by Hruska) of changing to constant voltage charging once the charge cut-off voltage is reached (*e.g.*, as opposed to stopping charging), a POSITA would have understood or found obvious that the “maximum potential” of the combination battery is the potential at which charging changes from constant current to constant voltage charging and thus is the **charge cut-off voltage** of the combination battery. APPLE-1004, [0017]; APPLE-1003, ¶63.

Alternatively or additionally, Yamaki explains that “the maximum potential of the positive electrode during charging *may be defined...based on the set*

charging voltage of the charger.” APPLE-1004, [0017]. To the extent the voltage of a charger can be considered a charge cut-off voltage of the battery itself, the “set charging voltage of the charger” is the maximum potential to which the battery is configured to be charged and thus is the **charge cut-off voltage** of the combination battery. APPLE-1004, [0017]; APPLE-1003, ¶64.

Yamaki’s charge cut-off voltages and voltage ranges, implemented in the combination battery (e.g., 4.4-4.8V or 4.4-4.6V) fall within the recited range of charge cut-off voltages (**greater than 4.2V but less than 5.8V**). APPLE-1004, [0028]; *see* [0014]-[0016], [0052]-[0054], [0057]; APPLE-1003, ¶¶65-67. In the combination, Yamaki’s range of charge cut-off voltages informs the obviousness of the recited voltage range: Yamaki-Sakamoto renders obvious that the combination battery has a **charge cut-off voltage of greater than 4.2V but less than 5.8V**. APPLE-1003, ¶68; *see Ineos USA LLC v. Berry Plastics Corp.*, 783 F.3d 865, 869 (Fed. Cir. 2015) (“When a patent claims a range...that range is anticipated by a prior art reference if the reference discloses a point within the range”); *Titanium Metals Corp. of Am. v. Banner*, 778 F.2d 775, 782 (Fed. Cir. 1985); *In re Petering*, 301 F.2d 676, 682, 49 C.C.P.A. 993, 1001, 133 USPQ 275, 280 (1962)).

[5b]

Positive and negative electrode materials

The combination battery includes **positive electrode material**, *e.g.*, based on Yamaki's positive electrode active material. *See* APPLE-1004, Abstract ("a positive electrode 1 containing *a Co-based oxide including Li and Co as a positive electrode active material*," where "[t]he Co-based oxide...contains at least one element selected from Mg, Al, Mn, Ti and Sr"), [0018], [0039], [0013], [0015]-[0016], [0020]-[0023], [0028]-[0029], [0045]-[0046], [0050], [0056]-[0060], claims 1-2; APPLE-1003, ¶69. It also includes **negative electrode material**, *e.g.*, based on Yamaki's "negative electrode active material." APPLE-1004, [0015]; *see* [0030]-[0031], [0006], [0013], [0016], [0041], Abstract, claim 1; APPLE-1003, ¶70.

The ratio of positive electrode material to negative electrode material

In the combination, "the *reversible capacity balance* of the positive electrode and the negative electrode" is " $1.05 < \text{negative electrode/positive electrode} \leq 1.30$," based on Sakamoto. APPLE-1005, [0007]; *see* §§IV.B.2-3, *supra*; APPLE-1003, ¶71. Sakamoto's "reversible capacity balance" is calculated as "the reversible capacity of the negative electrode" divided by "the reversible capacity of the positive electrode." APPLE-1005, [0007]; *see* Abstract, [0008], [0012], [0015]-[0016], claim 1; APPLE-1003, ¶71. The reciprocal of this

reversible capacity balance—the reversible capacity of the positive electrode divided by that of the negative electrode—is, in the combination, **the ratio of positive electrode material to negative electrode material, as calculated by a capacity** of the electrode active materials, as discussed in the following paragraphs. APPLE-1003, ¶¶71-73.

As explained by Hruska, the capacity of an electrode in a lithium secondary battery is provided by the electrode active material. APPLE-1003, ¶74. Thus, Sakamoto’s “reversible capacity balance” refers to the reversible capacity of the positive/negative electrode *active materials*. APPLE-1003, ¶75.

Furthermore, the capacity of an electrode active materials is a function of the capacity per unit mass of the material (*e.g.*, in milliamp hours per gram (mAh/g)) and the amount (*e.g.*, in grams) of the material in the battery. APPLE-1003, ¶76. Thus, the reciprocal of Sakamoto’s reversible capacity balance is the ratio between (1) the capacity per unit mass of the positive electrode active material times the mass of that material in the battery and (2) the capacity per unit mass of the negative electrode active material times the mass of that material, *e.g.*, expressed as follows. APPLE-1003, ¶¶77-79; *see* APPLE-1005, [0006]-[0007].

$$\text{Capacity balance (reciprocal)} = \frac{\left(\frac{\text{mAh}}{\text{g}}\right)_{\text{pos.electrode active material}}}{\left(\frac{\text{mAh}}{\text{g}}\right)_{\text{neg.electrode active material}}}$$

That is, the reciprocal of Sakamoto's reversible capacity balance is **the ratio of positive electrode material to negative electrode material as calculated by a capacity** of the electrode active materials. APPLE-1003, ¶80.

Sakamoto describes reversible capacity balances (*see* APPLE-1005, [0015]) for batteries having "a charge upper limit voltage," *e.g.*, a charge cut-off voltage, of 4.2V. APPLE-1005, [0016]; APPLE-1003, ¶81. In this context, a POSITA would have understood, or at least found obvious, that Sakamoto's reversible capacity balances (as applied to the combination battery) were **calculated by a capacity with a charge cut-off voltage set at 4.2V**, *e.g.*, because this calculation would be directly relevant to the test criteria applied to the batteries. *See* APPLE-1005, [0016]; APPLE-1003, ¶81.

Furthermore, a POSITA would have found obvious to calculate the reversible capacity balances **using a theoretic capacity**, given recognized advantages in using a theoretic capacity for the calculation (*e.g.*, as opposed to an experimentally determined value) and because this was conventional in battery design. APPLE-1003, ¶¶82-83.

The value of the ratio in the combination

The **ratio of positive electrode material to negative electrode material** in the combination battery (the reciprocal of Sakamoto's reversible capacity balance) is, *e.g.*, **1:1.05-1:1.30** (Sakamoto's "1.05 < negative electrode/positive electrode

≤ 1.30 ”) or **1:1.10-1:1.20** (Sakamoto’s “1.10 or more and 1.20 or less”). APPLE-1005, [0007]-[0008]; *see* [0012], [0015]-[0016], claim 1; APPLE-1003, ¶¶84-85. These ratios and ranges of ratios fall within the range of ratios recited in claim 5 (**1:1.0-1:2.5**). APPLE-1003, ¶86. In the combination, Sakamoto’s disclosure of these ratios thus informs the obviousness of the recited range of ratios: Yamaki-Sakamoto renders obvious a battery having positive and negative electrode material in **a ratio of from 1:1.0 to 1:1.25**. APPLE-1003, ¶87. *See Ineos*, 783 F.3d at 869, *Titanium Metals*, 778 F.2d at 782.

(ii) Claim 6

See [5a].³ The charge cut-off voltages of the combination battery (*e.g.*, **4.4V-4.8V**) fall within, and thus render obvious, the claimed range of voltages (**4.3V-5.2V**). *See Ineos*, 783 F.3d at 869; *Titanium Metals*, 778 F.2d at 782; APPLE-1003, ¶88.

(iii) Claim 7

See [5a]. The charge cut-off voltages of the combination battery (*e.g.*, **4.4V-4.8V**) fall within, and thus render obvious, the claimed range of voltages (**4.3V-4.8V**). *See Ineos*, 783 F.3d at 869; *Titanium Metals*, 778 F.2d at 782; APPLE-1003, ¶89.

³ Citations of this form incorporate by reference the text from the cited section.

(iv) **Claim 8**

See [5b]. The **ratios of positive electrode material to negative electrode material** in the combination battery (*e.g.*, **1:1.18, 1:1.30, 1:1.41, 1:1.50**; *see* APPLE-1005, [0015]) fall within, and thus render obvious, the claimed range of ratios (**1:1.15-1:2.5**). *See Ineos*, 783 F.3d at 869; *Titanium Metals*, 778 F.2d at 782; APPLE-1003, ¶90.

Alternatively or additionally, the range of ratios in the combination battery (**1:1.05-1.30** or **1:1.10-1:1.20**) overlaps with the recited range of ratios (**1:1.15-1:2.5**) and thus presents a *prima facie* case of obviousness of the claimed range, in the absence of criticality or unexpected results associated with the claimed range of ratios. APPLE-1003, ¶¶91-92. *See 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”); *In re Geisler*, 116 F.3d 1465, 1469–70 (Fed. Cir. 1997) (“When an applicant seeks to overcome a *prima facie* case of obviousness by showing improved performance in a range that is within or overlaps with a range disclosed in the prior art, the applicant must “show that the [claimed] range is *critical*, generally by showing that the claimed range achieves unexpected results relative to the *1470 prior art range,” quoting *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990)).

(v) **Claims 11-14**

Claims 11-14 do not recite structural features that further limit the secondary lithium ion cell or battery of claim 5, and thus are rendered obvious by Yamaki-Sakamoto at least as discussed *supra* for claim 5. *See Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1469 (Fed. Cir. 1990) (“[A]pparatus claims cover what a device *is*, not what a device *does*” (emphasis in original)); *Catalina Marketing Int’l v. Coolsavings.Com.*, 289 F.3d 801, 809 (Fed. Cir. 2002) (“[T]he patentability of apparatus or composition claims depends on the claimed structure, not on the use or purpose of that structure”); *In re Gardiner*, 171 F.2d 313, 315–316 (CCPA 1948) (“[T]he patentability of apparatus claims must be shown in the structure claimed and not merely upon a use, function, or result thereof.”). Nevertheless, to the extent claims 11-14 are afforded patentable weight, they are obvious over Yamaki-Sakamoto as discussed in the following paragraphs.

A POSITA would have found obvious that the Yamaki-Sakamoto battery has the claimed capacity retention

A POSITA would have understood, or at least found obvious, that the Yamaki-Sakamoto battery **maintains at least 75% of capacity after 400 cycles**, as recited in claim 11—or indeed, that the combination battery maintains any

reasonable arbitrary percentage of capacity, such as **at least 75.83%, 80%, or 80.72% of capacity**, as recited in claims 12-14.⁴ APPLE-1003, ¶¶93-103.

First, the '641 Patent provides no description of how to achieve the recited capacity retention beyond specifying the charge cut-off voltage and ratio. *See* APPLE-1001, Examples 1-28; APPLE-1003, ¶94. And as demonstrated *supra* in [5a]-[5b], the combination battery satisfies these charge cut-off voltage and ratio limitations that purportedly yield the recited capacity results. APPLE-1003, ¶94. It is inappropriate to hold the prior art to a stricter standard of disclosure than what is disclosed in the specification of the patent itself. *See In re Epstein*, 32 F.3d 1559, 1568 (Fed. Cir. 1994) (“the Board's observation that appellant did not provide the type of detail in his specification that he now argues is necessary in prior art references supports the Board's finding that one skilled in the art would have known how to implement the features of the references and would have concluded that the reference disclosures would have been enabling”). Because the disclosures of Yamaki-Sakamoto align with the elements that the '641 Patent

⁴ As agreed by the parties in co-pending litigation, Petitioner interprets “7500” as “75%,” *e.g.*, consistent with the similarly structured recitation of percentages in claims 12-18 and with relevant disclosure in the '641 Patent. *See* APPLE-1001, Tables 2-3; APPLE-1031, 7; APPLE-1003, ¶92.

indicates as providing the recited capacity retention, Yamaki-Sakamoto renders these claims obvious.

Alternatively or additionally, a POSITA would have found it obvious that Yamaki-Sakamoto battery **maintains at least 75%, 75.83%, 80%, or 80.72% capacity after 400 cycles**, based on the cycle life performance achieved by both Yamaki and Sakamoto and on the well-known cycle life behavior of secondary lithium batteries, as detailed here. APPLE-1003, ¶¶95-96.

The positive electrode composition of the combination battery, based on Yamaki (*see* [5b]), provides good cycle life by “*suppressing deterioration in the reversibility of charging and discharging*.” APPLE-1004, [0014]; APPLE-1003, ¶96. Indeed, Yamaki demonstrates **98% capacity** retention after 10 cycles. *See* APPLE-1004, [0057], [0028], [0059]; APPLE-1003, ¶97.

Moreover, in the combination, the positive/negative materials are provided according to Sakamoto’s reversible capacity balance, which also supports good cycle life, confirmed by Sakamoto (such batteries “*experience[] less deterioration after repeated charging and discharging*”) and well-known in the art. APPLE-1005, [0007]; *see* [0001], [0012], [0016]; *see* APPLE-1005, [0007]-[0008], [0012], [0017]; APPLE-1021, [0011]; APPLE-1019, 3:24-28; APPLE-1018, [0033]; APPLE-1003, ¶¶98-100.

In light of the cycle life enabled by ratios such as Sakamoto's, a POSITA would have expected a battery based on Yamaki, modified according to Sakamoto's reversible capacity balance, to have cycle characteristics at least as good as Yamaki's, if not better—that is, at least to retain Yamaki's 98% capacity after 10 cycles. *See* APPLE-1004, [0057]; APPLE-1003, ¶¶95-100.

Yamaki's 10 cycle measurement does not provide a complete picture of the cyclability of the battery; absent data regarding the longer term capacity retention, a POSITA would have found it reasonable to predict performance of the combination battery during testing across more cycles based on Yamaki's 10-cycle testing in conjunction with knowledge of performance of other, similar batteries. APPLE-1003, ¶101. Notably, many such batteries that exhibit high capacity retention after a small number of cycles (*e.g.*, consistent with the Yamaki-Sakamoto battery) exhibit significant capacity retention even after more (*e.g.*, hundreds) cycles. APPLE-1003, ¶102, citing APPLE-1015, 23.10; APPLE-1018, FIG. 3; APPLE-1016, 5:32-36; APPLE-1017, 5:10-17.

Given the high initial capacity retention of Yamaki-Sakamoto, and given high longer-term capacity retention of similarly performing lithium secondary batteries, it would have been reasonable for a POSITA to expect the Yamaki-Sakamoto battery to behave similarly during longer-term testing, *e.g.*, to **maintain**

at least 75%, 75.83%, 80%, or 80.72% of capacity after 400 cycles. APPLE-1003, ¶103.

A POSITA would have found it obvious to implement through routine experimentation a Yamaki-Sakamoto battery that has the claimed percent capacity retention

Still alternatively or additionally, a POSITA would have found it obvious to obtain a battery consistent with Yamaki-Sakamoto and that **maintains at least 75%, 75.83%, 80%, or 80.72% of capacity after 400 cycles**, based on routine experimentation guided by a goal of improving cycle life. APPLE-1003, ¶¶104-118.

Yamaki and Sakamoto share a common objective: improving cycle life. *See* APPLE-1004, [0014]; APPLE-1005, [0012]; APPLE-1003, ¶105. Furthermore, a generally accepted objective for a commercially viable battery is the ability to retain a significant capacity over a many cycles. APPLE-1003, ¶105, citing APPLE-1015, 23.10-23.11; APPLE-1016, 5:32-36; APPLE-1017, 5:10-17. A POSITA implementing the Yamaki-Sakamoto battery would thus have had cycle life in mind as a design criterion. APPLE-1003, ¶105.

In this design process, a POSITA would have been aware of the myriad factors that influence cycle life, discussed *infra*. APPLE-1003, ¶106. Indeed, the '641 Patent acknowledges that "[e]xcept voltage, all process parameters for charge and discharge are commonly used in the art." APPLE-1001, 9:22-23. Yet none of

these factors, other than charge cut-off voltage and material ratio, are specified in the claims. Guided by the goal of improving cycle life, it would have been a matter of routine experimentation for a POSITA to adjust these factors during longer-term testing, within the scope of the Yamaki-Sakamoto battery (*e.g.*, consistent with charge cut-off voltage and ratio ranges of the combination; *see* [5a]-[5b]), to optimize capacity retention—*e.g.*, to obtain a Yamaki-Sakamoto battery that **maintains at least 75%, 75.83%, 80%, or 80.72% of capacity after 400 cycles**. APPLE-1003, ¶¶106-107; *see In re Aller*, 220 F.2d 454, 456 (C.C.P.A. 1955) (“where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation”).

Charge cut-off voltage and ratio of positive to negative electrode active material both affect cycle life. *See* APPLE-1004, [0057]; APPLE-1006, [0067]-[0071]; APPLE-1005, [0015]-[0016]; APPLE-1021, [0011]; APPLE-1019, 3:24-28; APPLE-1018, [0033]; APPLE-1003, ¶¶108-109. Driven by the objective of improving cycle life, and recognizing the impact of charge cut-off voltage and electrode material ratio on cycle life, a POSITA would have found it obvious to adjust the charge cut-off voltage (*e.g.*, within the 4.4-4.8 V range of Yamaki-Sakamoto) and/or electrode material ratio (*e.g.*, within the 1:1.05-1:1.30 range of

the combination battery) as part of a routine optimization of cycle life. *See In re Aller*, 220 F.2d at 454; APPLE-1003, ¶110.

Other factors, including charge/discharge rates, ambient temperature, electrolyte purity, and electrolyte strength, also affect capacity retention. APPLE-1003, ¶¶111-114, citing APPLE-1015, FIG. 36.34; APPLE-1014, 1; APPLE-1016, 9:5-9. In implementing Yamaki-Sakamoto, it would have been mere routine experimentation to adjust these factors, guided by the objective of optimizing capacity retention. *See In re Aller*, 220 F.2d at 454; APPLE-1003, ¶¶115-116.

Notably, the '641 Patent provides no indication of these factors (*e.g.*, charge/discharge rate, ambient temperature, or electrolyte purity/strength) for its capacity retention testing. APPLE-1003, ¶117. Its failure to specify these factors, and its indication that its approach “can be widely used in various secondary lithium ion cells,” indicate that such factors can be determined via routine experimentation. APPLE-1001, 15:50-54. And as demonstrated *supra*, Yamaki-Sakamoto already satisfies the capacity ratio and charge cut-off voltage specified by the '641 Patent as relevant to achieving the claimed capacity retention percentages. *See* [5pre]-[5b]; APPLE-1003, ¶117. It is inappropriate to hold the prior art to a stricter standard of disclosure than what is disclosed in the specification of the patent itself. *See In re Epstein*, 32 F.3d at 1559. In its disclosure of capacity and charge cut-off voltage, Yamaki-Sakamoto aligns with

the disclosure of the '641 Patent with regard to factors associated with capacity retention, and thus is sufficient to render these claims obvious.

Moreover, the '641 Patent provides no indication of criticality or unexpected results associated with the 75%, 75.83%, 80%, or 80.72% values, or the 400 cycles. Rather, these are just arbitrary numbers. APPLE-1003, ¶117. Thus, identification of the optimum range of the various factors affecting cycle life, to achieve these arbitrary capacity retention targets, would have been merely a matter of routine experimentation. *See In re Aller*, 220 F.2d at 454.

Furthermore, in adjusting these factors to optimize capacity retention, a POSITA would have expected success, *e.g.*, given that these factors were known contributors to cycle life and capacity retention of lithium secondary batteries. APPLE-1003, ¶117.

Thus, consistent with the bounds on battery composition and operation imposed by Yamaki-Sakamoto, it would have been a matter of routine experimentation, adjusting factors such as charge cut-off voltage, material ratio, charge/discharge rate, temperature, or electrode purity or strength, to optimize capacity retention, *e.g.*, to obtain a battery that maintains an arbitrary percentage of its capacity—*e.g.*, **at least 75%, 75.83%, 80%, or 80.72% capacity after 400 cycles**. APPLE-1003, ¶¶106-117.

**C. [GROUND 1B] – CLAIMS 9-10 ARE OBVIOUS OVER
YAMAKI, SAKAMOTO, AND ABRAHAM**

The sections below provide a brief introduction to Abraham and the Yamaki-Sakamoto-Abraham combination.⁵

**1. Abraham describes electrolyte additives for
overcharge protection**

Abraham describes “redox reagents...to provide overcharge protection for cells having lithium metal or lithium-ion negative electrodes.” APPLE-1009, Abstract. Abraham’s overcharge protection involves a “redox shuttle” dissolved in the electrolyte and having “*an oxidation potential slightly higher than the normal charge limit of the cell* but lower than the oxidation potential of the electrolyte.” *Id.*, 2:20-38. When its oxidation potential is reached, “the redox shuttle is activated by its electrochemical conversion,” causing “[t]he cell potential during overcharge [to be] fixed at the oxidation potential of the redox shuttle,” thus providing overcharge protection. *Id.*, 2:23-29; APPLE-1003, ¶¶118-122.

Abraham explains that the redox reaction begins “when the cathode reaches the oxidation potential of the redox reagent,” and notes that “[j]udicious selection of the particular thianthrene will allow the overcharge protection agent to be tailored to the appropriate cell voltage.” APPLE-1009, 3:47-54. For instance, the

⁵ This discussion is incorporated into Ground 1B.

potential can be shifted “to more positive values” by “modify[ing] the thianthrene structure by replacing hydrogen atoms on the aromatic rings with electron withdrawing groups.” *Id.*, 4:7-14; *see* 5:11-14; APPLE-1003, ¶123. In an example, when the cathode is “ LiMn_2O_4 ,” “a shuttle activated at a potential between 4.2 and 4.5V” can be used. *Id.*, 5:15-19; APPLE-1003, ¶124.

Importantly, Abraham does not limit applicability of its redox shuttle, indicating suitability of implementation in a broad class of lithium batteries including those having compositions and charge cut-off voltages consistent with those of the Yamaki-Sakamoto battery. APPLE-1003, ¶125.

2. Yamaki-Sakamoto-Abraham combination

In Yamaki-Sakamoto-Abraham, a redox shuttle is “added to the electrolyte where it is available for a reversible oxidation-reduction (redox) shuttle reaction,” based on Abraham. APPLE-1009, 3:33-35; APPLE-1003, ¶126. The redox shuttle is a compound, *e.g.*, a thianthrene derivate, that has been “tailored to the appropriate cell voltage,” *e.g.*, such that it has an oxidation potential “slightly higher than” the 4.4V-4.8V charge cut-off voltage of the combination battery. APPLE-1009, 2:36-38, 3:47-54; APPLE-1003, ¶126. For instance, the redox shuttle can be a “thianthrene structure [modified] by replacing hydrogen atoms on the aromatic rings with electron withdrawing groups” to obtain a compound having a suitable oxidation potential. APPLE-1009, 4:7-10; APPLE-1003, ¶126.

In an overcharge situation, *e.g.*, when the positive electrode of the combination battery reaches “a potential slightly above” the charge cut-off voltage, “the redox shuttle is activated by its electrochemical conversion,” thus providing overcharge protection. APPLE-1009, 2:23-33; APPLE-1003, ¶127. When the voltage decreases, *e.g.*, to below the oxidation potential of the redox shuttle, the redox reaction no longer proceeds and normal charging/discharging operation of the battery resumes. *See* APPLE-1009, 2:27-29; APPLE-1003, ¶127.

3. Reasons for the combination

A POSITA would have been motivated to implement Yamaki-Sakamoto-Abraham for various reasons. APPLE-1003, ¶¶128-136.

First, a POSITA would have been motivated to provide overcharge protection to avoid degradation of battery performance, particularly in the absence of any specific implementation limits imposed by Abraham. For instance, a POSITA would have been motivated to avoid the “irreversible electrolyte side-reactions which deteriorate cell performance” that can be caused by overcharging. APPLE-1009, 1:54-56; *see* APPLE-1026, 1:24-25; APPLE-1008, 1; APPLE-1003, ¶¶129-130.

Second, a POSITA would have been motivated to implement overcharge protection to mitigate safety risks associated with overcharging, again in the

absence of any specific implementation limits imposed by Abraham. *See* APPLE-1026, 1:26-27; APPLE-1008, 1-2; APPLE-1003, ¶¶131-132.

Third, in view of the generic applicability of Abraham’s disclosure, a POSITA would have been motivated to use a redox shuttle for overcharge protection to obtain advantages of “[c]hemical overcharge protection,” *e.g.*, over “electronic overcharge controllers.” APPLE-1009, 1:65-2:1; APPLE-1003, ¶133. For instance, electronic overcharge protection “lower[s] the energy density of the battery and increase[s] battery cost.” APPLE-1009, 2:1-2; *see* APPLE-1027, [0009]; APPLE-1003, ¶133. A POSITA would have opted for chemical overcharge protection to avoid reductions in energy density and to maintain a low cost battery system. APPLE-1003, ¶133.

Fourth, in light of the general applicability of Abraham’s disclosure, a POSITA would have been motivated to pursue a redox shuttle implementation for overcharge protection because, in the context of a multi-cell battery, “[c]hemical overcharge protection” advantageously “provide[s] capacity balance among the individual cells and prevent[s] oxidative degradation of the electrolyte.” APPLE-1009, 2:3-5; APPLE-1003, ¶¶134-135. For instance, a POSITA would have pursued this approach to obtain these benefits, and the resulting increase in cycle life for the battery. *See* APPLE-1009, 2:5-19; APPLE-1003, ¶¶134-135.

Fifth, a POSITA would have been prompted to pursue this implementation because doing so is merely the application of known techniques (*e.g.*, chemical overcharge protection) by a known system (*e.g.*, the Yamaki-Sakamoto battery) to yield predictable results (*e.g.*, a secondary lithium battery having chemical overcharge protection). APPLE-1003, ¶136; *see KSR*, 550 U.S. at 417.

A POSITA would have expected success in pursuing this combination for various reasons. APPLE-1003, ¶¶137-143.

First, a POSITA would have expected success because both Abraham's battery and the Yamaki-Sakamoto battery are secondary lithium ion batteries with similar materials systems. APPLE-1003, ¶¶138-141; *see* APPLE-1004, Abstract, [0018], [0030]-[0031], [0033]; APPLE-1009, 3:36-39, 6:4-10, 5:27-32, 5:47-49. And as noted *supra*, none of Yamaki, Sakamoto, or Abraham provides any indication that the features of their respective batteries would not be suitable for integration by the others. APPLE-1003, ¶141.

Second, a POSITA would have expected success because of Abraham's teachings of the flexibility of its redox shuttle approach, *e.g.*, indicating its suitability for use with the 4.4-4.8V charge cut-off voltage of the combination battery. APPLE-1003, ¶142. For instance, Abraham notes that "[t]he choice of a particular redox reagent will vary with the cathode material," and indicates the suitability of its approach for "high voltage cathodes." APPLE-1009, 5:44-46,

5:63; APPLE-1003, ¶142. Moreover, Abraham provides guidance on choosing, making, and characterizing a suitable redox reagent. *See* APPLE-1009, 4:7-10, 5:11-15, 5:55-57; APPLE-1003, ¶142.

Third, a POSITA would have expected success given that use of redox shuttle additives for overcharge protection in secondary lithium batteries was known as of the Critical Date, and Abraham's promotions in a similarly broad manner. *See* APPLE-1008, 1-2; APPLE-1030, Abstract; APPLE-1003, ¶143.

4. Analysis

(i) Claim 9

The Yamaki-Sakamoto-Abraham battery includes a “redox shuttle... dissolved in the electrolyte” of the combination battery, *e.g.*, based on Abraham. APPLE-1009, 2:20-23; *see* Abstract, 1:13-18, 2:48-56, 3:20-35, 3:47-54, 5:11-19, claim 1; APPLE-1003, ¶144. The **overcharging protection voltage** of the combination battery corresponds to the “oxidation potential” of the redox shuttle, *e.g.*, because the oxidation potential is the voltage at which “the redox shuttle is activated by its electrochemical conversion,” thereby causing “[t]he cell potential

during overcharge [to be] fixed at the oxidation potential of the redox shuttle.”

APPLE-1009, 2:23-27; *see* 3:47-54; APPLE-1003, ¶145.⁶

The oxidation potential of the redox shuttle in the combination—and thus the overcharging protection voltage of the combination—is “*slightly higher than the normal charge limit of the cell* but lower than the oxidation potential of the electrolyte.” APPLE-1009, 2:36-38; *see* 3:47-54, 5:12-15; APPLE-1003, ¶145.

The charge limit of the combination cell, *e.g.*, the charge cut-off voltage, is “*from 4.4 V to 4.8 V.*” APPLE-1004, [0014]; *see* [5a], *supra*. Thus, the overcharging protection voltage of the combination battery is “slightly higher than” a voltage that is between 4.4V and 4.8V (*e.g.*, slightly higher than a voltage of 4.4V, 4.5V, or 4.6V; *see* APPLE-1004, [0057]), *i.e.*, **the overcharging protection voltage is greater than 4.35V**. APPLE-1009, 2:36-38; *see* 3:47-54, 4:7-10, 5:12-18, 5:44-57; APPLE-1003, ¶¶145, 148. Indeed, Abraham describes the use of redox shuttles that are “activated at *potentials between 4.2 and 4.5V*,” and thus that provide an overcharging protection voltage greater than 4.35V. APPLE-1009, 5:17-18; APPLE-1003, ¶¶145, 148.

⁶ The ’641 Patent indicates that “[t]he type and structure” of the overcharging protection “shall not be specifically restricted.” APPLE-1001, 9:29-31.

When the voltage falls below the oxidation potential of the redox shuttle, the redox shuttle reaction no longer proceeds, and charging/discharging of the battery can resume, *e.g.*, the overcharging protection provided by the redox shuttle is released. *See* APPLE-1009, 2:26-33; APPLE-1003, ¶¶146-148. The oxidation potential of the redox shuttle thus also corresponds to the **overcharging protection release voltage** of the battery. As discussed *supra*, the oxidation potential of the redox shuttle in the combination is greater than 4.35V, and thus **the overcharging protection release voltage** of the combination battery is also greater than 4.35V, *i.e.*, **greater than 4.15V**. APPLE-1003, ¶¶146-148.

(ii) Claim 10

See [9]. The combination battery has an overcharging protection voltage “slightly higher than” a voltage that is between 4.4V-4.8V (*e.g.*, slightly higher than a voltage of 4.5V or 4.6V; *see* APPLE-1004, [0057]), *i.e.*, **the overcharging protection voltage is greater than 4.45V**. APPLE-1009, 2:36-38; *see* 5:17-18; APPLE-1003, ¶149. Additionally, the **overcharging release voltage is greater than 4.25V**, at least because the overcharging release voltage also corresponds to the oxidation potential of the redox shuttle, which is greater than 4.45V. APPLE-1003, ¶149.

**D. [GROUND 2A] – CLAIMS 5-14 ARE OBVIOUS OVER
YASUNAMI AND KOYAMA**

The sections below provide a brief introduction to Yasunami, Koyama, and their combination.⁷

1. Yasunami describes a lithium battery having a high end-of-charge voltage

Yasunami describes a “non-aqueous secondary battery having a high battery voltage, high discharge capacity (high energy density), and long charge/discharge cycle life.” APPLE-1006, [0006]; *see* [0001]; APPLE-1003, ¶150.

Yasunami’s “negative electrode active material is a lithium-containing transition metal oxide represented by Li_xMO_j .” APPLE-1006, [0007]. The “positive electrode active material may be a transition metal oxide capable of reversibly occluding and releasing lithium ions,” such as “a lithium-containing transition metal oxide” *Id.*, [0007], [0021]; *see* [0021]; APPLE-1003, ¶¶151-152. When the battery is charged/discharged, “the valence of the transition metal [of the positive/negative electrode active materials] is changed by occluding and releasing lithium ions.” APPLE-1006, [0044]; APPLE-1003, ¶153.

Yasunami’s battery can be charged to a “end-of-charge voltage...in the range from 3.5 to 4.7 V.” APPLE-1006, [0034]; APPLE-1003, ¶154.

⁷ This discussion is incorporated into Grounds 2A-2B.

Yasunami places “no particular restrictions on the use ratio for the positive electrode active material and the negative electrode active material,” stating that “the ratio is preferably set so that the effective equivalents of each are equal (an effective equivalent is the equivalent that can substantially maintain cycle performance)” but noting that “either the positive electrode active material or the negative electrode active material” can be increased. APPLE-1006, [0019]; APPLE-1003, ¶¶155-159.

2. Koyama describes a lithium secondary battery in which positive and negative electrode active materials are provided according to a specified range of capacity ratios

Koyama describes “a nonaqueous electrolyte secondary battery,” that has “better charging characteristics than the prior art.” APPLE-1007, [0001], [0005]. This improvement is achieved by setting a “capacity ratio (B/A) between the electrode capacity A of the positive electrode and the electrode capacity B of the negative electrode” to “ $1.3 < (B/A) \leq 2.5$.” *Id.*, Abstract, [0006]; APPLE-1003, ¶160. Such a capacity ratio “is effective in achieving excellent characteristics such as a charge density above 400 (-W/kg).” *Id.*, [0027]. Specifically, “[i]f the capacity ratio (B/A) is less than 1.3, the improvement in charging characteristics is insufficient,” while “the capacity ratio (B/A) exceed[ing] 2.5,...result[s] in a

decrease in battery capacity and an increase in irreversible capacity.” *Id.*, [0007]; APPLE-1003, ¶162.

Like Yasunami’s battery, Koyama’s battery includes a “positive electrode active material[]” that is an “inorganic compound[] such as metal oxides of alkali metals,” such as “Li-containing transition metal oxides.” APPLE-1007, [0008].

The negative electrode active material also can be a “metal oxide[],” such as a lithium-containing transition metal oxide. *Id.*, [0009]; APPLE-1003, ¶161.

Koyama places no particular restrictions on charge cut-off voltage, and it identifies batteries that are consistent with aspects of Yasunami’s batteries. APPLE-1003, ¶161.

3. Yasunami-Koyama combination

In Yasunami-Koyama, a lithium secondary cell based on Yasunami includes positive and negative electrode active materials in amounts that satisfy a capacity ratio based on Koyama. APPLE-1003, ¶163.

The composition of the electrodes and electrolyte of the combination battery is based on Yasunami. APPLE-1003, ¶¶164-166. The combination battery includes a “negative electrode active material” that “is a lithium-containing transition metal oxide.” APPLE-1006, [0007]; APPLE-1003, ¶164. Additionally, as per Yasunami, the “positive electrode active material may be a transition metal oxide” such as “a lithium-containing transition metal oxide.” APPLE-1006,

[0007], [0021]; APPLE-1003, ¶165. The composition of the electrolyte is also based on Yasunami. *See* APPLE-1006, [0048]-[0051]; APPLE-1003, ¶166. Notably, these electrode and electrolyte compositions are consistent with the compositions of Koyama's battery. *See* APPLE-1007, [0008]-[0009], [0015]; APPLE-1003, ¶¶164-166.

The combination battery includes positive and negative electrode active material in amounts such that the capacity ratio (B/A) between the capacity of the positive electrode active material and the capacity of the negative electrode active material is in the range of " $1.3 < (B/A) \leq 2.5$," based on Koyama. APPLE-1007, [0006]; APPLE-1003, ¶167.

In operation, the end-of-charge voltage of the combination battery is 3.5V-4.7V, as taught by Yasunami. *See* APPLE-1006, [0034]; APPLE-1003, ¶168. Importantly, the combination battery does not risk decomposition of the positive electrode active material or the electrolyte (*see* APPLE-1006, [0034]) because the composition of the positive electrode active material and electrolyte are consistent with those described by Yasunami and thus compatible with this range of voltages. APPLE-1003, ¶168.

Notably, the combination battery maintains the advantages of "high battery voltage, high discharge capacity (high energy density), and long charge/discharge cycle life," at least because it retains the composition of the positive/negative

electrode active materials and the end-of-charge voltage that Yasunami identifies as providing these advantages. *See* APPLE-1006, [0006]-[0007]; APPLE-1003, ¶169. Moreover, by providing a ratio of positive to negative electrode active materials that is specified by Koyama, the “charging density” of the battery is further enhanced according to Koyama. *See* APPLE-1007, Abstract; APPLE-1003, ¶169.

4. Reasons for the combination

A POSITA would have been motivated to implement Yasunami-Koyama for various reasons. APPLE-1003, ¶¶170-175.

First, a POSITA would have been motivated to pursue improvements in charging performance (*e.g.*, charge rate) that are enabled by providing electrode materials that satisfy Koyama’s range of capacity ratios, particularly given Yasunami’s teaching that such a ratio may be appropriate. *See* APPLE-1007, [0007], [0027]; APPLE-1006, [0019]; APPLE-1003, ¶¶171-172. Koyama describes that electrode materials satisfying the 1.3-2.5 range of capacity ratios are “effective in achieving excellent characteristics such as a charge density above 400 (-W/kg),” noting that “[i]f the capacity ratio (B/A) is less than 1.3, the improvement in charging characteristics is insufficient,” while “if the capacity ratio (B/A) exceeds 2.5,” this “result[s] in a decrease in battery capacity.” APPLE-1007, [0007], [0027]; *see* [0005], [0010], [0027], [0029]; APPLE-1003, ¶¶171-

172. Improved charging performance can enable advantages such as more efficient (faster) charging of the battery. APPLE-1003, ¶¶171-172. A POSITA would have been motivated to implement a capacity ratio such as that described by Koyama to obtain a battery with better charging performance, *e.g.*, with the objective of producing a faster charging battery. *Id.*

Second, a POSITA would have recognized the well-known safety advantages of a battery in which there is more capacity in the negative electrode than in the positive—*e.g.*, as described by Koyama—and would have been motivated to improve safety of the combination battery, again encouraged by Yasunami’s teaching that such a ratio may be appropriate. *See* APPLE-1005, [0007]-[0008], [0017]; APPLE-1006, [0019]; APPLE-1020, 5; APPLE-1022, [0017]; APPLE-1018, [0033]; APPLE-1003, ¶173.

Third, a POSITA would have understood that batteries having more capacity in the negative electrode than in the positive—*e.g.*, a battery satisfying the capacity ratio described by Koyama and consistent with ratios indicated as suitable by Yasunami—have good cycle life characteristics, and would therefore have been motivated to obtain a battery with good capacity retention over a long cycle life. *See* APPLE-1005, [0006]-[0008], [0012], [0017]; APPLE-1006, [0019]; APPLE-1018, [0033]; APPLE-1021, [0011]; APPLE-1019, 3:24-28; APPLE-1004, Abstract; APPLE-1003, ¶174. For instance, a POSITA implementing Yasunami’s

battery—in which there can be more negative than positive material capacity, *see* APPLE-1006, [0019]—would have explored batteries having known ratios of positive/negative electrode active materials, such as those described by Koyama, following Yasunami’s general guidance regarding the amounts of these materials. APPLE-1003, ¶174.

Fourth, a POSITA would have been prompted to pursue this implementation because doing so is merely the application of known techniques (*e.g.*, a secondary lithium ion battery having more negative electrode capacity than positive electrode capacity, per Koyama) by a known system (*e.g.*, Yasunami’s battery) to yield predictable results (*e.g.*, a secondary lithium ion battery having negative electrode active material and positive electrode active material in amounts to satisfy a specific known capacity ratio, and having a charge cut-off voltage range). APPLE-1003, ¶175; *see KSR*, 550 U.S. at 417. And as noted *supra* in §IV.B.4, the ’641 Patent itself acknowledges that its purportedly inventive charge cut-off voltage applies to conventional secondary lithium ion batteries. *See* APPLE-1001, 1:24-28, 7:51-56, 8:37-55.

A POSITA would have expected success in pursuing this combination for various reasons. APPLE-1003, ¶¶176-182.

First, a POSITA reviewing Yasunami would have understood that selecting a desired amount of positive/negative electrode material, *e.g.*, to achieve

performance objectives (*e.g.*, charging performance, safety, and/or cycle life, as discussed *supra*), is consistent with Yasunami's disclosure that "[t]he ratio of the positive electrode active material to the negative electrode active material... depends on the types of active materials to be combined." APPLE-1006, [0032]; *see* [0019] ("There are no particular restrictions on the use ratio for the positive electrode active material and the negative electrode active material...At the time, either the positive electrode active material or the negative electrode active material is preferably increased"); APPLE-1003, ¶177.

Second, a POSITA would have expected success because both Yasunami and Koyama describe secondary lithium ion batteries with similar materials systems. APPLE-1003, ¶¶178-181; *see* APPLE-1006, [0007], [0021], [0048]-[0051]; APPLE-1007, [0008]-[0009], [0015]. And as noted *supra*, neither Yasunami nor Koyama provides any indication that the features of their respective batteries would not be suitable for integration by the other. APPLE-1003, ¶181. Indeed, Yasunami even indicates the possibility of providing more negative electrode material capacity than positive, consistent with the specific implementation described by Koyama. *See* APPLE-1006, [0019]; APPLE-1003, ¶181.

Third, a POSITA would have expected success given that secondary lithium ion batteries having more negative than positive electrode capacity, as well as the

operation of such batteries with a charge cut-off voltage of greater than 4.2 V, were well-known in the art, and disclosures of each were commonly described, as in Yasunami and Koyama, without precluding the other. *See* APPLE-1020, 5; APPLE-1021, [0011]; APPLE-1007, [0006]; APPLE-1023, 1:25-35; APPLE-1024, 40:3-14; APPLE-1025, 2:63-3:3; APPLE-1012, 1; APPLE-1003, ¶182.

5. Analysis

(i) Claim 5

[5pre]

To the extent the preamble is deemed to be limiting, Yasunami-Koyama renders it obvious. APPLE-1003, ¶¶183-185.

First, in the combination, Yasunami describes “a non-aqueous *secondary battery* having *a negative electrode material that is a lithium-containing transition metal oxide* represented by Li_xMO_j ...and *a positive electrode active material that is a lithium-containing transition metal oxide* represented by Li_yNO_z ,” *e.g.*, a **secondary battery**. APPLE-1006, Abstract; *see* [0001], [0006]-[0009], [0032]-[0033], [0073], claims 1-9; APPLE-1003, ¶184.

Specifically, Yasunami’s secondary battery in the combination is a **lithium ion cell or battery**, at least because movement of lithium ions occurs during charging/discharging. APPLE-1003, ¶185. For instance, Yasunami describes that in operation of its battery, “the valence of the transition metal” of both the positive

electrode active material and the negative electrode active material “is changed by *occluding and releasing lithium ions during charging and discharging.*”

APPLE-1006, [0044]; *see* [0021], [0015], [0026]; APPLE-1003, ¶185.

[5a]

Yasunami’s end-of-charge voltage is a charge cut-off voltage of the combination battery

In the combination, the “non-aqueous secondary battery” has “*an end-of-charge voltage of 3.5 to 4.7 V,*” based on Yasunami. APPLE-1006, [0073]; *see* [0034], [0066], [0068], claim 1, Tables 1-3; §§IV.D.1, 3, *supra*; APPLE-1003, ¶186. This end-of-charge voltage is the **charge cut-off voltage** of the combination battery, as discussed in the next paragraphs. APPLE-1003, ¶¶186-191.

A POSITA would have understood, or at least found obvious, that Yasunami’s “end-of-charge voltage” is a **charge cut-off voltage** at least because it is the maximum voltage to which the combination battery is configured to be charged, *e.g.*, the voltage at which charging of the battery is stopped. APPLE-1006, [0034]; *see* [0066]-[0067] (“Charging/discharging cycle testing was performed on the prepared batteries at *a final charge voltage* of 3.9 to 4.3 V,” shown as “*End-of-Charge Voltage*” in Table 1), [0068]-[0069]; APPLE-1003, ¶187.

For instance, a POSITA would have understood, or at least found obvious, for Yasunami's "end-of-charge voltage" to be the voltage at which the charging of the combination battery changes from constant current charging to constant voltage charging—that is, the **charge cut-off voltage**—consistent with conventional charging techniques for secondary lithium batteries and given the advantages of this approach to battery charging, as explained further by Hruska. APPLE-1003, ¶¶188-191.

Yasunami's end-of-charge voltage values are a disclosure of, or otherwise render obvious, the claimed range of charge cut-off voltages

The **charge cut-off voltage** of the combination battery is "**3.5 to 4.7 V**," based on Yasunami. APPLE-1006, [0073]; *see* [0034] ("The end-of-charge voltage is preferably in the range from **3.5 to 4.7 V**, more preferably from 3.7 to 4.5V, and even more preferably from 3.8 to 4.4 V."), [0066], claim 1, [0068], Tables 1-3; APPLE-1003, ¶192.

In the combination, at least one of the charge cut-off voltages disclosed by Yasunami (**4.3V**; *see* APPLE-1006, [0067] (line 1 of Table 1), [0069] (line 1 of Table 2), [0071] (No. 4 in Table 3)) falls within the range of charge cut-off voltages recited in claim 5, thus informing the obviousness of the recited charge cut-off voltage range. APPLE-1003, ¶193. *See Ineos USA LLC v. Berry Plastics Corp.*, 783 F.3d at 865; *Titanium Metals Corp. of Am. v. Banner*, 778 F.2d at 775.

Alternatively or additionally, the charge cut-off voltage range recited in claim 5 overlaps with the noted range of charge cut-off voltages of the combination battery (e.g., *between 3.5V-4.7V*, as disclosed by Yasunami). APPLE-1003, ¶194. In the absence of any indication of criticality or unexpected results, as discussed *infra*, the overlapping range of charge cut-off voltages described by Yasunami presents a *prima facie* case and renders obvious the recited range.⁸ *See In re Peterson*, 315 F.3d at 1329; *In re Geisler*, 116 F.3d at 1469–70.

Specifically, the '641 Patent fails to demonstrate that the 4.2 V lower limit of its claimed range of charge cut-off voltages achieves any unexpected results relative to the charge cut-off voltage range disclosed by Yasunami. APPLE-1003, ¶¶195-197.

The '641 Patent fails even to present results for experiments conducted at charge cut-off voltages below 4.2V, instead presenting data with charge cut-off voltages starting at a minimum of 4.2V. *See* APPLE-1001, 10:29-12:55 (Examples 1-28); APPLE-1003, ¶197. Without a demonstration of the behavior of cells charged to a charge cut-off voltage *below* 4.2 V, there is no way to conclude that 4.2 V is a threshold for onset of unexpected results or criticality. APPLE-1003, ¶196.

⁸ A similar analysis renders obvious dependent claims 6-7, discussed *infra*.

Instead, the '641 Patent characterizes its putative lower charge cut-off voltage threshold of 4.2 V as being “well accepted as a technical requirement in the industry.” APPLE-1001, 1:46-49; APPLE-1003, ¶197. As an initial matter, an industry standard technical requirement is not a demonstration of criticality or unexpected results. The '641 Patent further asserts—by explanation only, and without any experimental support—that this industrial “technical requirement” is because, in batteries with a charge cut-off voltage above 4.2V, “the positive electrode materials and negative electrode materials will undergo structure change, the electrolyte may decompose, and the recycle properties of the cell will be adversely effected.” APPLE-1001, 1:55-52. This assessment, though, is directly contradicted by not only Yasunami (*see* APPLE-1006, [0034]) but also numerous art references demonstrating the viability of secondary lithium ion batteries operating with a charge cut-off voltage of greater than 4.2V. *See* APPLE-1023, 1:25-35; APPLE-1024, 40:3-14; APPLE-1025, 2:63-3:3; APPLE-1012, 1; APPLE-1003, ¶197.

Thus, absent any demonstration of criticality or unexpected results of the claimed range of charge cut-off voltages, Yasunami renders obvious the claimed range. APPLE-1003, ¶¶195-197.

[5b]

Positive and negative electrode materials

The Yasunami-Koyama battery includes **positive electrode material**, *e.g.*, based on Yasunami's "**positive electrode active material**," which "is a lithium-containing transition metal oxide represented by Li_yNO_z ." APPLE-1006, [0007]; *see* [0009], [0044], [0019]-[0030], [0032], [0035], [0042], [0049], [0058], [0064], [0070]-[0071], [0073], claims 1 and 9; §§IV.D.2-3, *supra*; APPLE-1003, ¶198. It also includes **negative electrode material**, *e.g.*, Yasunami's "negative electrode active material," which "is a lithium-containing transition metal oxide represented by Li_xMO_j ." APPLE-1006, [0007]; *see* [0009], [0044], [0017]-[0020], [0028], [0031]-[0032], [0035], [0042], [0045], [0049], [0058], [0062]-[0063], [0073], Tables 1-3, claims 1 and 4-8; APPLE-1003, ¶199.

The ratio of positive electrode material to negative electrode material in the combination battery

In the combination, the "the capacity ratio (B/A) between the electrode capacity A of the positive electrode and the electrode capacity B of the negative electrode is $1.3 < (B/A) \leq 2.5$," based on Koyama. APPLE-1007, [0006]; APPLE-1003, ¶200. The reciprocal of Koyama's capacity ratio—A/B—is, in the combination battery, **the ratio of positive electrode material to negative electrode material, as calculated by a capacity** of the electrode active materials, as discussed in the following paragraphs. APPLE-1003, ¶200.

As discussed *supra* in [5b] of Ground 1A, the capacity of an electrode in a lithium secondary battery is a function of the capacity per unit mass of the electrode active material and the amount of the electrode active material in the electrode. APPLE-1003, ¶201. Thus, the reciprocal of Koyama's capacity ratio is the ratio between (1) the capacity per unit mass of the positive electrode active material times the mass of the positive electrode active material and (2) the capacity per unit mass of the negative electrode active material times the mass of the negative electrode active material. APPLE-1003, ¶¶201-202.

That is, the reciprocal of Koyama's capacity ratio, in the combination battery, is **the ratio of positive electrode material to negative electrode material as calculated by a capacity** of the electrode active materials. APPLE-1003, ¶203.

Moreover, in the combination, Koyama's capacity ratio (*e.g.*, as applied to the combination battery) is **calculated by a theoretic capacity**: "the electrode capacity A of positive electrode 1 was derived *from the theoretical capacity*." APPLE-1007, [0017]; APPLE-1003, ¶204.

Furthermore, a POSITA would have understood, or at least found obvious, that the capacity ratios are calculated by a capacity **with a charge cut-off voltage set at 4.2V**. APPLE-1003, ¶205. For instance, Koyama notes that, in the context of experiments in which "the samples were charged...to an upper voltage of 4.2 V," "*the electrode capacity B of negative electrode 2 was derived* from the

measured value.” APPLE-1007, [0017], [0022]. Because the capacity ratio—which is dependent upon the measured capacity of the negative electrode—is a variable in these tests to 4.2V, a POSITA would have recognized that the capacity of the negative electrode at 4.2V is a relevant quantity, and thus would have understood or found obvious for the capacity of the negative electrode to be measured at an “upper voltage” (e.g., a charge cut-off voltage) of 4.2V. APPLE-1007, [0022]; APPLE-1003, ¶205. Moreover, a POSITA would have understood this or found it obvious because it was conventional for capacity values to be determined and/or provided with respect to a 4.2V charge cut-off voltage. APPLE-1003, ¶205.

The value of the ratio in the combination

In the combination battery, positive electrode active material and negative electrode active material are provided in amounts such that the “the capacity ratio (B/A) between the electrode capacity A of the positive electrode and the electrode capacity B of the negative electrode is $1.3 < (B/A) \leq 2.5$,” based on Koyama.

APPLE-1007, [0006]; see [0007], [0012] (“the capacity ratio (B/A)...is $1.3 < (B/A) \leq 2.5$, specifically, $B/A = 1.40$ ”), [0017]-[0019], claim 1; APPLE-1003, ¶206. The **ratio of positive electrode material to negative electrode material** in the combination battery (the reciprocal of Koyama’s capacity ratio) is thus, e.g.,

1:1.3-1:2.5 (Koyama's " $1.3 < (B/A) \leq 2.5$ ") or **1:1.40** (Koyama's " $B/A = 1.40$ ").

APPLE-1007, [0006], [0012]; APPLE-1003, ¶207.

These ratios and ranges of ratios fall within the range of ratios recited in claim 5 (**1:1.0 to 1:2.5**), thus informing the obviousness of the recited range of ratios: Yasunami-Koyama renders obvious a battery having positive electrode material and negative electrode material in **a ratio of from 1:1.0 to 1:1.25**.

APPLE-1003, ¶¶208-209. *See Ineos*, 783 F.3d at 869, *Titanium Metals*, 778 F.2d at 782.

(ii) Claim 6

The **4.3V** charge cutoff voltage of the combination falls within, and thus renders obvious, the claimed range of voltages (**4.3V-5.2V**). *See* [5a]; *see Ineos*, 783 F.3d at 869; *Titanium Metals*, 778 F.2d at 782; APPLE-1003, ¶210.

Alternatively or additionally, the **3.5-4.7V** charge cut-off voltage range of the combination overlaps with, and thus, in the absence of any indication of criticality or unexpected results, renders obvious the claimed range of voltages. *See* [5a]; *see In re Peterson*, 315 F.3d at 1329; *In re Geisler*, 116 F.3d at 1469-70. For instance, while the '641 Patent measures the percent capacity retention after 400 cycles using charge cut-off voltages ranging from 4.2V-5.9V, there is no onset of different behavior or significantly different results beginning at 4.3V. Rather, the '641 Patent measures 84.23% capacity retention in a battery charged to 4.2V,

85.12% capacity retention in a battery charged to 4.3V, and 83.45% capacity retention in a battery charged to 4.6V. *See* APPLE-1001, Table 2; *see also* similar results in Tables 3-4; APPLE-1003, ¶211.

(iii) Claim 7

The **4.3V** charge cutoff voltage of the combination falls within, and thus renders obvious, the claimed range of voltages (**4.3V-4.8V**). *See* [5a]; *see Ineos*, 783 F.3d at 869; *Titanium Metals*, 778 F.2d at 782. Alternatively or additionally, the **3.5-4.7V** charge cut-off voltage range of the combination overlaps with, and thus renders obvious, the claimed range of voltages, at least because the '641 Patent provides no indication of criticality or unexpected results associated with this claimed range, as discussed in [7], *supra*. *See In re Peterson*, 315 F.3d at 1329; *In re Geisler*, 116 F.3d at 1469-70; APPLE-1003, ¶¶212-213.

(iv) Claim 8

See [5b]. In the combination, the **ratio of positive electrode material to negative electrode material (1:1.3-1:2.5, or 1:1.40)** falls within, and thus renders obvious, the claimed range of ratios (**1:1.15-1:2.5**). *See Ineos*, 783 F.3d at 869; *Titanium Metals*, 778 F.2d at 782; APPLE-1003, ¶214.

(v) Claim 9

In the combination, Yasunami describes that the “charger” of its battery “may also be provided with a circuit that incorporates measures against

overcharging and overdischarging.” APPLE-1006, [0060]. To the extent that the operation of a charger can be considered as providing a battery with overcharging protection and overcharging protection release voltages, a POSITA would have understood, or at least found to be obvious, that a circuit such as that provided in Yasunami’s charger, and implemented in the combination battery, has **an overcharging protection voltage and an overcharging protection release voltage**, *e.g.*, because this is conventional functionality of overcharging protection circuits that enable these circuits to provide overcharging protection. *See* APPLE-1028, 1:25-30, 4:55-65 (“if the cell voltage reaches an over-charging protection voltage, as a pre-set voltage, the detection control IC 3 outputs...[an] over-charging control signal” to “enable[] prohibition of over-charging to the battery cell”), 5:50-62; APPLE-1003, ¶215. The overcharging protection voltage of such a circuit is the voltage at which operation of the circuit is triggered, *e.g.*, to prevent overcharging damage. APPLE-1003, ¶215. The overcharging protection release voltage is the voltage at which the circuit disengages. *Id.*

A POSITA would have understood or found obvious that the overcharging protection voltage of the charger is slightly higher than the charge cut-off voltage of the combination battery. APPLE-1003, ¶216. Indeed, this is conventional, and enables the battery to reach its full charge cut-off voltage without interruption by the protection circuit. *Id.* (citing APPLE-1029, 10:1-65, 15:35-40). The charge

cut-off voltage of the combination battery is 3.5-4.7V. Thus, at least when the battery is configured to have a charge cut-off voltage of at least 4.35V (within the combination battery's range), the **overcharging protection voltage** of the protection circuit is likewise **greater than 4.35V**. *Id.*

A POSITA also would have understood or found obvious that the overcharge protection release voltage of the protection circuit is slightly below the overcharging protection voltage. APPLE-1003, ¶217. Again, this is conventional, *e.g.*, enabling charge/discharge cycling to resume once the positive electrode voltage returns to its normal operational range. APPLE-1003, ¶217 (citing APPLE-1029, 10:1-65). When the charge cut-off voltage of the battery is greater than 4.35V, as discussed in the preceding paragraph, the **overcharging protection release voltage** thus is at or slightly below 4.35V, *i.e.* **greater than 4.15V**. APPLE-1003, ¶217.

(vi) Claim 10

See [9]. A POSITA would have understood or found obvious that at least when the combination battery has a charge cut-off voltage within the disclosed 3.5-4.7V range and at least 4.45V, the **overcharging protection voltage** of the protection circuit is likewise **greater than 4.45V**, and the **overcharge protection release voltage**, which is slightly less than the overcharging protection voltage, is **greater than 4.25V**. APPLE-1003, ¶218.

(vii) **Claims 11-14**

As noted *supra* for Ground 1A, claims 11-14 do not recite structural features that further limit the secondary lithium ion cell or battery of claim 5, and thus are met by Yasunami-Koyama at least as discussed *supra* for claim 5. *See Hewlett-Packard*, 909 F.2d at 1469; *Catalina Marketing*, 289 F.3d at 809; *In re Gardiner*, 171 F.2d at 315–316. Nevertheless, to the extent claims 11-14 are afforded patentable weight, they are obvious over Yasunami-Koyama as discussed in the following paragraphs.

A POSITA would have found obvious that the Yasunami-Koyama battery has the claimed capacity retention

A POSITA would have understood, or at least found obvious, that the Yasunami-Koyama battery **maintains at least 75% capacity retention after 400 cycles**, as recited in claim 11—or indeed, that the combination battery maintains any reasonable arbitrary percentage of capacity, such as **at least 75.83%, 80%, or 80.72% of capacity**, as recited in claims 12-14. APPLE-1003, ¶¶219-223.

First, as discussed *supra* for Ground 1A, the '641 Patent provides no description of how to achieve the recited capacity retention beyond the specified charge cut-off voltage and electrode material ratios, which, as demonstrated *supra* in [5a]-[5b], are satisfied by Yasunami-Koyama. APPLE-1003, ¶220. Because the disclosures of Yasunami-Koyama align with the elements that the '641 Patent

indicates as providing the recited capacity retention, Yasunami-Koyama renders these claims obvious. *See In re Epstein*, 32 F.3d at 1559; APPLE-1003, ¶220.

Alternatively or additionally, a POSITA would have found it obvious that the Yasunami-Koyama battery **maintains at least 75%, 75.83%, 80%, or 80.72% capacity after 400 cycles** based on the cycle life performance demonstrated for Yasunami's battery and the effect of the material ratio provided by the combination with Koyama, and further based on the well-known cycle life behavior of secondary lithium batteries, as detailed here and *supra* in [11]-[14] of Ground 1A. APPLE-1003, ¶221.

The positive and negative electrode active materials of the combination battery are lithium-containing transition metal oxides (*see* [5b]), which achieve “good charge/discharge cycle characteristics.” APPLE-1006, Abstract; *see* [0006]-[0007], [0001], [0020]-[0021]; APPLE-1003, ¶222. Indeed, Yasunami achieves over 200 cycles “before the discharge capacity reached 60% of the initial value.” APPLE-1006, [0066]; APPLE-1003, ¶222.

Moreover, in the combination, the positive/negative materials are provided in amounts satisfying Koyama's capacity ratio. APPLE-1003, ¶223. It was well-known that having more negative electrode capacity than positive (as is the case here) was beneficial for cycle life. *See* APPLE-1005, [0007]-[0008], [0012],

[0017]; APPLE-1021, [0011]; APPLE-1019, 3:24-28; APPLE-1018, [0033];
APPLE-1003, ¶223.

Thus, because of the cycle life benefits enabled by ratios such as Koyama's, a POSITA would have expected the Yasunami-Koyama battery to have cycle characteristics at least as good as Yasunami's, if not better—*e.g.*, to **maintain at least 75%, 75.83%, 80%, or 80.72% of capacity after 400 cycles**. APPLE-1003, ¶¶219-223.

A POSITA would have found it obvious to implement through routine experimentation a Yasunami-Koyama battery that has the claimed percent capacity retention

Still alternatively or additionally, a POSITA would have found it obvious to obtain a battery consistent with Yasunami-Koyama and that **maintains at least 75%, 75.83%, 80%, or 80.72% of capacity after 400 cycles**, based on routine experimentation guided by a goal of improving cycle life. APPLE-1003, ¶¶224-229.

Yasunami aims to improve cycle life. *See* APPLE-1006, Abstract (“To provide a non-aqueous secondary battery having...good charge/discharge cycle characteristics”); APPLE-1003, ¶225. Furthermore, as discussed *supra* for [11]-[14] in Ground 1A, improving cycle life is also a generally accepted objective for design of a commercially viable battery. *Id.*

As also discussed *supra* for [11]-[14] in Ground 1A, a POSITA implementing the Yasunami-Koyama battery with cycle life in mind as a design criterion would have been aware of factors influencing cycle life, including charge cut-off voltage, electrode material ratio, electrolyte purity/strength, charge/discharge rate, and ambient temperature. *See* APPLE-1004, [0057]; APPLE-1006, [0067]-[0071]; APPLE-1005, [0015]-[0016]; APPLE-1015, 36.46; APPLE-1014, 1; APPLE-1016, 5:5-9; APPLE-1003, ¶226. Guided by the objective of improving cycle life, it would have been a matter of routine experimentation for a POSITA to adjust these factors (none of which is specified in the claims), within the scope of Yasunami-Koyama (*e.g.*, consistent with charge cut-off voltage and ratio ranges of the combination; *see* [5a]-[5b]), to optimize capacity retention—*e.g.*, to obtain a Yasunami-Koyama battery that **maintains at least 75%, 75.83%, 80%, or 80.72% of capacity after 400 cycles**. APPLE-1003, ¶¶226-228; *see* [11]-[14] of Ground 1A; *In re Aller*, 220 F.2d 454. Indeed, identification of the optimum range of factors influencing cycle life, to achieve an arbitrary percentage capacity retention would have been merely a matter of routine experimentation, particularly in view of the lack of detail in the '641 Patent and the purportedly generic applicability of its teachings, and in view of the lack of criticality of the recited values, discussed *supra* for [11]-[14] of Ground 1A. APPLE-1003, ¶229; *see* APPLE-1001, 15:50-54; *In re Aller*, 220 F.2d at 454; *In re*

Epstein, 32 F.3d at 1559. Moreover, a POSITA would have expected success in this endeavor, *e.g.*, given that these factors were known contributors to cycle life and capacity retention. *See* [11]-[14] of Ground 1A; APPLE-1003, ¶¶228-229.

Thus, consistent with the bounds on the battery composition and operation imposed by Yasunami-Koyama, it would have been a matter of routine experimentation, adjusting well-known factors that affect cycle life, to optimize capacity retention, *e.g.*, to obtain a battery that maintains an arbitrary percentage of its capacity—*e.g.*, **at least 75%, 75.83%, 80%, or 80.72%**, as recited in claims 11-14. APPLE-1003, ¶¶224-229.

**E. [GROUND 2B] – CLAIMS 9-10 ARE OBVIOUS OVER
YASUNAMI, KOYAMA, AND RICHARDSON**

The sections below provide a brief introduction to Richardson and the Yasunami-Koyama-Richardson combination.⁹

**1. Richardson describes electrolyte additives for
overcharge protection**

Richardson describes “redox shuttle additives for overcharge protection in rechargeable batteries.” APPLE-1008, 1-2. The oxidation of such additives “allows the additive(s) to transport an electric charge through the cell without

⁹ This discussion is incorporated into Ground 2B.

damage to the cell,” thus providing overcharge protection. *Id.*, 3; APPLE-1003, ¶¶230-232.

Richardson provides a list of additives that “can act...as redox shuttles under moderate overcharge conditions.” APPLE-1008, 5. These additives have an “Onset Potential” ranging from 3.72-5.05V. *Id.*, 5-6, *see* Table II. The onset potential of an additive is its oxidation potential, *e.g.*, the potential at which the redox reaction is initiated. *See id.*, 1 (“an electrolyte additive that acts as an internal current shunt when the charging potential exceeds a characteristic onset potential”); APPLE-1003, ¶233.

Importantly, Richardson does not limit applicability of its redox shuttle, indicating suitability of implementation in a broad class of lithium batteries including those having compositions and charge cut-off voltages consistent with those of the Yasunami-Koyama battery. APPLE-1003, ¶234.

2. Yasunami-Koyama-Richardson combination

In Yasunami-Koyama-Richardson, the electrolyte includes a redox shuttle additive, *e.g.*, such as those listed in Richardson’s Table II. *See* APPLE-1008, 4-6; APPLE-1003, ¶235. The implemented additive has an onset voltage higher than the charge cut-off voltage of the combination battery, *e.g.*, higher than a voltage “in the range from 3.5 to 4.7 V.” APPLE-1006, [0034]; APPLE-1003, ¶235.

In an overcharge situation, *e.g.*, when the potential of the positive electrode of the combination battery exceeds the charge cut-off voltage and reaches the onset voltage of the additive, the additive undergoes a redox reaction, thus providing overcharge protection. *See* APPLE-1008, 3; APPLE-1003, ¶¶236-237. When the voltage decreases below the onset voltage of the redox shuttle, the redox reaction no longer proceeds and normal charging/discharging operation of the battery resumes. *See* APPLE-1008, 2; APPLE-1003, ¶¶236-237.

3. Reasons for the combination

A POSITA would have been motivated to implement Yasunami-Koyama-Richardson for various reasons. APPLE-1003, ¶¶238-243.

First, a POSITA would have been motivated to provide overcharge protection to avoid degradation of battery performance that can result from overcharge, particularly absent specific implementation limits imposed by Richardson. *See* §IV.C.3; APPLE-1009, 1:54-56; APPLE-1026, 1:24-25; APPLE-1008, 1; APPLE-1003, ¶239.

Second, a POSITA would have been motivated to implement overcharge protection to mitigate safety risks associate with overcharging, again absent specific implementation limits imposed by Richardson. *See* §IV.C.3; APPLE-1026, 1:26-27; APPLE-1008, 1-2; APPLE-1003, ¶240.

Third, still in view of Richardson's generic applicability, a POSITA would have been motivated to use a redox shuttle for overcharge protection because of advantages of chemical overcharge protection. *See* §IV.C.3; APPLE-1009, 1:65-2:2; APPLE-1027, [0009]; APPLE-1003, ¶241.

Fourth, in light of Richardson's general applicability, a POSITA would have been motivated to use a redox shuttle for overcharge protection because of the cycle life advantages of this approach for multi-cell batteries. *See* §IV.C.3; APPLE-1009, 2:3-19; APPLE-1003, ¶242.

Fifth, a POSITA would have been prompted to pursue this implementation because doing so is merely the application of known techniques (*e.g.*, chemical overcharge protection) by a known system (*e.g.*, Yasunami-Koyama battery) to yield predictable results (*e.g.*, a secondary lithium battery having chemical overcharge protection). APPLE-1003, ¶243; *see KSR*, 550 U.S. at 417.

A POSITA would have expected success in pursuing this combination various reasons. APPLE-1003, ¶¶244-251.

First, a POSITA would have expected success because the Yasunami-Koyama battery and Richardson's battery are secondary lithium ion batteries with similar materials systems. APPLE-1003, ¶¶245-249; *see* APPLE-1006, [0048], Abstract; APPLE-1008, 3-4, 6-7, Abstract. And as noted *supra*, none of Yasunami, Koyama, or Richardson provides any indication that the features of

their respective batteries would not be suitable for integration by the others.

APPLE-1003, ¶249.

Second, a POSITA would have expected success because, in the combination, Yasunami indicates that its electrolyte can contain additives consistent with the redox shuttle additives described by Richardson. APPLE-1006, [0053]; *see* APPLE-1008, Table II; APPLE-1003, ¶250.

Third, a POSITA would have expected success given that use of redox shuttle additives for overcharge protection in secondary lithium batteries was known as of the Critical Date. *See* APPLE-1009, Abstract; APPLE-1030, Abstract; APPLE-1003, ¶251.

4. Analysis

(i) Claim 9

The Yasunami-Koyama-Richardson battery includes a “redox shuttle additive[,]” such as those described by Richardson. APPLE-1008, 3; APPLE-1003, ¶252. The **overcharging protection voltage** of the combination battery corresponds to the “Onset Potential” of the redox shuttle additive, *e.g.*, because when the battery voltage reaches the onset potential, the redox shuttle “transport[s] an electrical charge through the cell without damage to the cell,” preventing further voltage increase and providing overcharge protection. APPLE-1008, 3, 5; APPLE-1003, ¶252.

Several of the redox shuttle additives listed in Richardson's Table II have an onset potential of greater than 4.35V. *See* APPLE-1008, 5-6; APPLE-1003, ¶253. When any suitable one of these additives is incorporated into the electrolyte of the combination battery, **the overcharging protection voltage** of the battery is **greater than 4.35V**. APPLE-1003, ¶253. For instance, when the charge cut-off voltage of the combination battery is towards the high end of the "3.5 to 4.7 V" range of charge cut-off voltages of the combination battery (*e.g.*, 4.3V; *see* APPLE-1006, [0067], [0069]), a POSITA would have recognized the suitability of a redox shuttle additive providing an overcharging protection voltage greater than the charge cut-off voltage, *e.g.*, greater than 4.35V. APPLE-1006, [0034]; APPLE-1003, ¶254.

When the voltage of the combination battery falls below the oxidation potential of the redox shuttle, the redox shuttle reaction no longer proceeds, and charging/discharging of the battery can resume, *e.g.*, the overcharging protection provided by the redox shuttle is released. *See* [9] of Ground 1B, *supra*; APPLE-1009, 2:26-33; APPLE-1003, ¶255. The oxidation potential of the redox shuttle thus also corresponds to the **overcharging protection release voltage** of the battery. As discussed *supra*, the oxidation potential of the redox shuttle in the combination is greater than 4.35V, and thus **the overcharging protection release**

voltage of the combination battery is also greater than 4.35V, *i.e.*, **greater than 4.15V**. APPLE-1003, ¶255.

(ii) Claim 10

See [9]. When the combination includes a redox shuttle additive having an onset potential of greater than 4.45V, the battery has **an overcharging protection voltage of greater than 4.45V**. *See* APPLE-1008, 5-6 (Table II); APPLE-1003, ¶256. Additionally, the **overcharging release voltage is greater than 4.25V**, at least because the overcharging release voltage also corresponds to the oxidation potential of the redox shuttle, which is greater than 4.45V. APPLE-1003, ¶256.

V. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

A. §314(a)

The Board should not discretionarily deny based on the *Fintiv* factors.

Factor 1 is neutral; neither party has requested a stay in co-pending litigation.

Factor 2 is neutral based on an expected Final Written Decision date in February 2025, which is within a few months of the likely trial date. In particular, the median time-to-trial date for CDCA is currently 25.8 months, which would suggest a likely trial date in December 2024. *See* https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_distprofile0331.2023.pdf, 68.

Factor 3 favors institution; Petitioner has diligently filed this Petition months ahead of the one-year time bar, while the CDCA litigation is still in its early stages and investment minimal.

Factor 4 favors institution; if the Board institutes trial, Petitioner stipulates not to seek resolution in the district court of any ground of invalidity that utilizes the primary references asserted in this Petition (*i.e.*, Yamaki and Yasunami).

Factor 5 is neutral; parties in the parallel litigation are the same.

Factor 6 favors institution; the Petition presents a compelling case of invalidity.

B. §325(d)

Advanced Bionics and the *Becton* factors strongly favor institution.

Under the *Advanced Bionics* framework, discretionary denial under §325(d) is appropriate only if a condition in the framework's first prong is satisfied, and if there is no showing of material error under the second prong. *Advanced Bionics LLC v. MED-EL Elektromedizinische Gerate GmbH*, IPR2019-01469 Pap. 6 (PTAB Feb. 13, 2020). The first prong concerns whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office. *Advanced Bionics.*, 8-10.

Here, none of the references relied upon in this Petition was presented to the Office during prosecution. *See* APPLE-1001, Cover.

Moreover, arguments presented in this Petition are substantively distinct from arguments considered during prosecution in connection with the '641 Patent. As discussed *supra* in §III.B, the issue that arose during prosecution was whether it was proper to introduce a higher charge cut-off voltage into Idota's battery. *See* APPLE-1002, 103-104. But this is not the question raised by the combinations advanced in this Petition. Here, the primary reference is ***already*** an operable secondary lithium battery with a charge cut-off voltage within the claimed range; that battery is then implemented such that its positive/negative electrode materials are provided in a certain ratio. That is, the issue raised in this Petition is not the question—previously resolved during prosecution—of whether to modify a secondary battery to operate with a higher charge cut-off voltage, but instead the ***substantively distinct*** question of whether to modify a functional secondary battery that already operates at that higher charge cut-off voltage to have specified amounts of positive/negative electrode materials.

Importantly, these substantively distinct questions have substantively distinct answers. Arguments presented by Applicant during prosecution are not relevant to the combinations presented in this Petition. Applicant relied on evidence purporting to demonstrate the poor performance of batteries having

higher charge cut-off voltages as support for the non-obviousness of the Examiner's proposed modification of Idota to operate at a high cut-off voltage. *See* APPLE-1002, 45-51. Yet here, both combinations rely on a high performance battery with a charge cut-off voltage already in the claimed range, and that is further modified based on the secondary reference; this obviates the relevance of the prosecution arguments related to purported disadvantages of high cut-off voltages. Moreover, the art relied on here describes *secondary* batteries, thus again rendering inapposite an argument that the introduction of a higher cut-off voltage would not result in a secondary battery.

Moreover, Applicant's arguments made during prosecution are not pertinent to the combinations advanced herein. Rather, this Petition presents combinations of references—and arguments promoting those combinations—that have not previously been considered by the Office.

Because neither condition of the first prong of the *Advanced Bionics* framework is met, there is no need to reach the second prong to resolve against discretionary denial under §325(d). *See, e.g., Oticon Medical AB et. al. v. Cochlear Ltd.*, IPR2019-00975 Pap. 15, 20 (PTAB Oct. 16, 2019)(precedential).

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.

VIII. 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 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 IPR50095-0143IP1@fr.com.

Respectfully submitted,

Dated: August 23, 2023

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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 totals 13,995 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: August 23, 2023

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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 August 23, 2023, 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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