

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner

v.

RJ TECHNOLOGY LLC,
Patent Owner.

Case IPR2023-01183
Patent No. 7,749,641

PATENT OWNER'S PRELIMINARY RESPONSE

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EXHIBIT LIST	
2001	C. Love, et al., <i>Impedance Diagnostic for Overcharged Lithium-Ion Batteries</i> , Electrical and Solid-State Letters 15, pp. A53-A56 (2012)

I. INTRODUCTION

Patent Owner RJ Technology LLC (“Patent Owner” or “RJ”) submits this Preliminary Response to Petitioner Samsung Electronics Co., Ltd.’s (“Petitioner” or “Samsung”) July 21, 2023 Petition (Paper 1) requesting *inter partes* review of claims 1-18 (the “Challenged Claims”) of U.S. Patent No. 7,749,641 (the “’641 Patent”).

The claims of the ’641 Patent recite—among other elements—an improved lithium-ion battery for which (i) the charge cut-off voltage is “greater than 4.2 V but less than 5.8 V” (the “claimed voltage range”) and (ii) the ratio of positive electrode material to negative electrode material is “from 1:1.0 to 1:2.5 as calculated by a specific capacity with a charge voltage limited to 4.2V” (the “claimed capacity ratio range”). As the ’641 patent explains in detail, the prior art universally regarded 4.2V as the upper boundary voltage to which a battery could be recharged without suffering significant loss of performance. The patented invention identifies a novel combination in which the two claimed ranges operate *in tandem* to raise that boundary without suffering significant performance losses seen in prior art batteries, while also conferring key benefits:

The present invention provides a new method for *improving capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery*. This method is achieved *by means of properly adjusting the ratio between a positive material and negative material*,

which is calculated by theoretical specific energy, ***and properly increasing charge cut-off voltage***. Abstract (emphasis added)

There is no question that the claimed ranges are critical to enabling the claimed benefits, *i.e.*, “improving the capacity, average operating voltage and specific energy of a secondary lithium-ion cell or battery” without the undesirable effects caused at such voltage levels. Petitioner’s expert Dr. Juzkow has put forth several opinions that confirm the indisputable criticality of these ranges, as taught in the ’641 Patent and the prior art. In short, Dr. Juzkow has opined that: (i) extra lithium could be extracted from the cathode by raising the cut-off voltage, (ii) that extra lithium could cause problems, (iii) those problems could be addressed by raising the amount of anode in the battery relative to the cathode, and (iv) raising the anode above a certain limit could itself cause problems, namely waste. His opinions confirm the criticality of the claimed ranges as taught in the ’641 Patent, which teaches substantially elevated cut-off voltage and capacity ratio ranges versus the prior art.

Against this backdrop, Petitioner asserts two references—Abe and Uemura—that do not disclose the claimed ranges and teach against charging within the voltage range taught by the ’641 Patent. Petitioner bases its grounds primarily on ambiguous disclosures in Abe and Uemura of ranges that could be interpreted to overlap with the claimed ranges but do not, in fact, overlap. Setting aside whether the prior art ranges overlap or not, however, the law is clear: a claimed range that is critical to

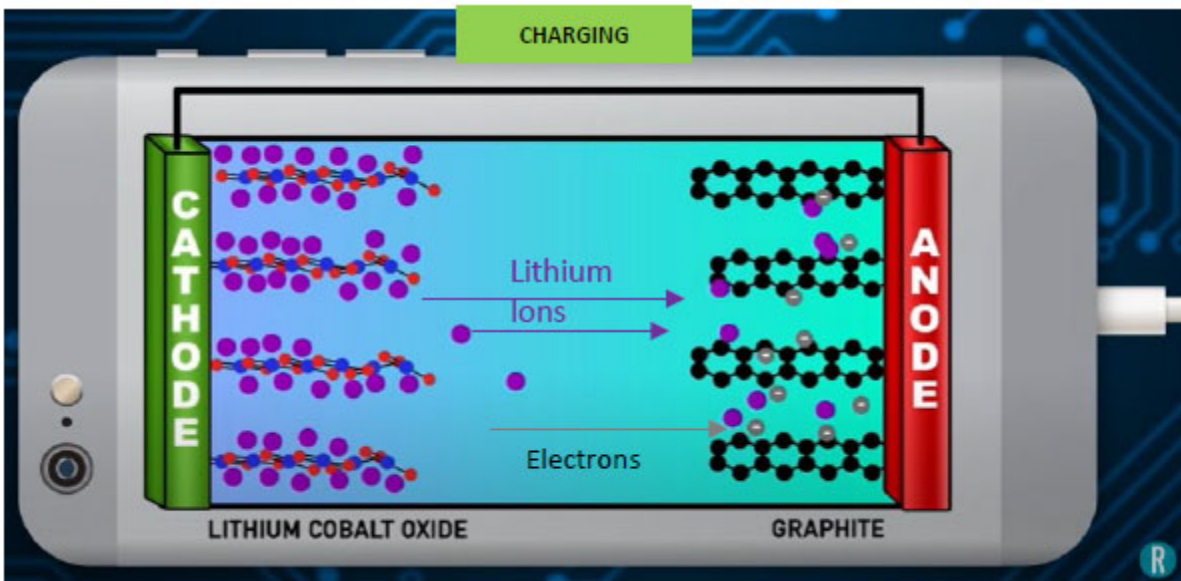
the claimed invention cannot be anticipated by a partly overlapping prior art range. Here, Petitioner's expert admits that the claimed ranges are critical; therefore, even if Abe and Uemura disclose values within the claimed ranges, they do not anticipate as a matter of law. Further, because Abe and Uemura teach against charging a battery within these critical ranges, they likewise cannot render the claimed ranges obvious.

For these reasons, and those explained in more detail below, Patent Owner respectfully requests denial of institution.

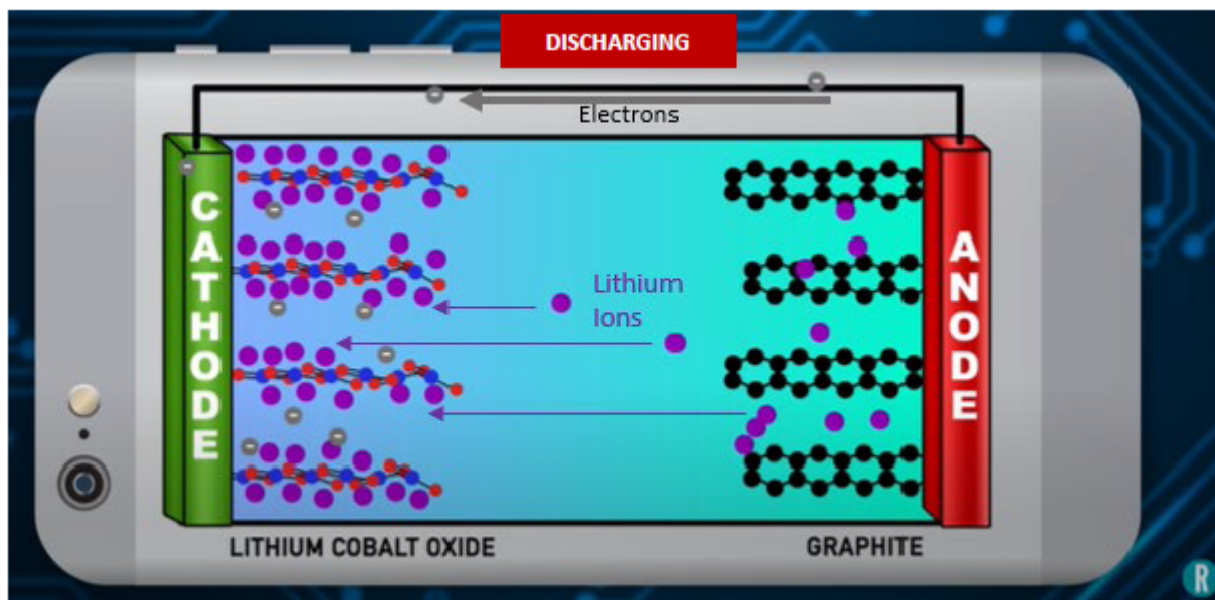
II. BACKGROUND

A. The History Behind RJ Technology's Invention

Introduced commercially in the early 1990s, lithium-ion (or "Li-ion") batteries are the now-ubiquitous power source for mobile phones, electric cars, laptops, and other portable electronic devices. At a basic level, the batteries include a positive electrode (a cathode), a negative electrode (an anode), and a chemical layer between them (the electrolyte, which is often a solution). '641 Patent at 2:38–41, 1:36–63. When the battery is charged, lithium ions flow through the electrolyte and become embedded in the anode, at the same time the electrons flow through the charging circuit and enter the cathode:



When the device is unplugged, the battery provides electricity (the flow of electrons) as the electrons flow through the device, and the lithium ions flow back through the electrolyte to the cathode.



Battery engineers had long worked unsuccessfully to increase the lithium-ion battery capacity (the amount of energy held on a charge) without losing

performance, for example, by changing the electrode materials, the electrolyte, or the cell shape. '641 Patent at 1:19–35.

The '641 Patent inventors took a different approach, focusing on the charge cutoff voltage. *Id.* at 1:19–63, 2:63–67. Voltage measures the force at which electrons are pushed through a circuit. Increasing the charging voltage pushes a larger number of lithium ions to the anode, but can cause the batteries to degrade, and harm performance—for example, by substantially reducing the capacity of the battery. *Id.* at 1:57–63. Thus, at that time of the invention, 4.2V was the universally accepted maximum cutoff voltage for Li-ion batteries. *Id.* at 1:46–49.

The '641 Patent describes the inventors' unique solution to increasing capacity with an improved battery design, including with respect to the chemistry of the batteries and parameters like charging voltage, overcharge protection, and overcharge release. Key among their innovations was the determination through experimentation that capacity could be improved without sacrificing performance by “increasing the charge cut-off voltage” above 4.2V and simultaneously “adjusting the ratio of positive electrode material to negative electrode material.” *Id.* at 3:7–12, 55–65. This unique and previously unknown combination of battery design elements was found to be novel and patentable by the patent examiner, resulting in issuance of the '641 Patent.

B. The '641 Patent

The '641 Patent is titled “Secondary Lithium Ion Cell or Battery, and Protecting Circuit, Electronic Device, and Charging Device of the Same” and describes “improving [the] capacity, average operating voltage, and specific energy of a secondary lithium ion cell or battery [by] adjusting the ratio between a positive material and a negative material, which is calculated by theoretical specific energy, and properly increasing charge cut-off voltage.” '641 Patent, abstract. The invention “provide[s] a secondary lithium ion cell or battery, wherein the single secondary lithium ion cell has an [sic] charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.” '641 Patent, 3:26-33.

Contrary to the prior art, which discouraged charging of secondary cell batteries at a charge cut-off voltage greater than 4.2V, the inventors of the '641 Patent recognized that it was possible to improve the capacity, average operating voltage, and specific energy of a secondary lithium-ion battery—without degrading battery performance—by applying in tandem (i) a higher charge cut-off voltage range and (ii) a lower ratio of positive electrode material to negative electrode material (as determined at 4.2V):

As to the common opinion in the art that increasing the charge cut-off voltage above 4.2 V may greatly shorten the recycle life, the inventor of the present invention conducted a large number of experiments and studies to elevate the charge cut-off voltage and the capacity of cell. Contrary to this opinion, the inventor unexpectedly found that the efficacy of electrode active materials is greatly increased by increasing the charge cut-off voltage and properly adjusting the ratio of positive electrode material to negative electrode material of single lithium ion cell. Consequently, the specific energy, capacity and average operating voltage of secondary lithium ion cell or battery are improved, while the performance of cell is substantially not changed. The present invention is fulfilled based on the aforesaid discovery.

'641 Patent, 3:3-16.

Contrary to the prior art, the charge cut-off voltage of the single cell of said secondary cell or battery is greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material calculated by the theoretical capacity under the charge cut-off voltage of 4.2 V is 1:1.0 to 1:2.5. As compared to the prior secondary lithium ion cell or battery cell, the capacity, energy density and output voltage of the present secondary lithium ion cell or battery are greatly improved, while its recycle life is equivalent to that of the prior art cell. For achieving better effect, the aforesaid charge cut-off voltage used in the present invention is preferably in the range from 4.3 V to 5.2 V, more preferably in the range from 4.3 V to 4.8 V. In addition, the ratio of positive electrode material to negative electrode material of said single lithium ion cell, which is calculated by the theoretical capacity

under the charge cut-off voltage of 4.2 V, is 1:1.5 to 1:2.5.

'641 Patent, 7:25-50.

Critically, the '641 Patent discloses that including anode material such that the ratio of positive electrode material to negative electrode material is within the disclosed ranges allowed raising the charge cut-off voltage within the claimed ranges without jeopardizing the performance of the battery—a well-known concern in the prior art in connection with charging lithium-ion batteries above 4.2V. '641 Patent, 6:29-34.

C. Prosecution History

The '641 Patent is the U.S. national stage of PCT application No. PCT/CN02/00696 filed September 28, 2002, which claims priority to Chinese application No. CN01141615 filed September 28, 2001. The '641 Patent issued on July 6, 2010, after overcoming a series of rejections made by the Office.

Petitioner asserts that the “prosecution history of the child to the '641 patent shows that the '641 patent was mistakenly allowed” because the '641 Patent’s inventors abandoned a child application of the '641 Patent—Application No. 12/817,028 (the “'028 child application”)—after “the examiner refused to allow the child application even though the applicants relied on the same arguments and the same limitations that led to the allowance of the '641 patent.” Pet., 3.

Petitioner mischaracterizes the prosecution history. The claims of the child

application are different in scope than the claims of the '641 Patent as they lack elements that were critical to the patentability of the '641 Patent. In particular, claim 4 of the '028 child application—the only independent claim remaining at the time of abandonment—states:

4. An electronic device using a secondary lithium ion cell or battery as energy source, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first ***overcharging protection voltage*** of greater than 4.35 V, and an ***overcharge protection release voltage*** of greater than 4.15 V, and wherein the ratio of positive electrode material to negative electrode material of the single lithium ion cell is from 1:1.0 to 1:2.5, as calculated by the theoretic capacity with the charge cut-off voltage set at 4.2 V.

Ex. 1004, 23.

By contrast, independent claim 5 of the '641 Patent states:

5. A secondary lithium ion cell or battery, characterized in that the secondary lithium ion cell or battery has ***a charge cut-off voltage of greater than 4.2 V but less than 5.8 V***, and 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.

'641 Patent, claim 5.

Plainly, independent claim 4 of the '028 child application is not directed to

the claimed charge cut-off voltage range in the '641 patent recited in claim 5 of the '641 Patent's ("a charge cut-off voltage of greater than 4.2 V but less than 5.8 V"), only to the "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." Given that "a charge cut-off voltage of greater than 4.2 V but less than 5.8 V" is absent from the claims of the child application, applicant's abandonment of the '028 child does not (as Petitioner asserts here) suggest that the claims of the '641 Patent—which recite different limitations, including a combination of the claimed charge cut-off voltage range with the claimed capacity ratio range—are not patentable.

Nor does the child application support Petitioner's insinuation that the child prosecution encompassed important new prior art that had not been considered by the examiner of the '641 Patent. Since the claims were significantly different, the different prior art relied upon in the child application has no discernible application to the distinct claim limitations in the '641 Patent. Indeed, Petitioner does not connect any disclosure in the prior art of the child application to the limitations of the '641 Patent and does not rely upon any of that prior art as grounds against the independent claims of the '641 Patent. Petitioner also fails to acknowledge that the prior art on which the child application's examiner was focused in issuing rejections—the Idota reference (U.S. Pat. No. 5,260,148)—was considered in

connection with the '641 Patent application and that examiner found the claims at issue here patentable over that art. Ex. 1003 at 23. In short, Petitioner's passing reference to the child application is a distraction.

D. Petitioner's Cited References

The Petition asserts the following ten grounds:

Ground	Claims	Basis
#1	1-8	§ 102(e) by Uemura
#2	1-8	§ 103 by Uemura
#3	11-18	§ 103 by Uemura
#4	11-18	§ 103 by Uemura and Guyomard
#5	1-8	§ 102(b) by Abe
#6	1-8	§ 103 by Abe
#7	2-4, 6-8, 11-18	§ 103 by Abe and Guyomard
#8	9	§ 103 by Uemura and Iwaizono
#9	9-10	§ 103 by Uemura, Iwaizono, and Guyomard
#10	9-10	§ 103 by Abe, Guyomard, and Iwaizono

Paper 1, 7.

Petitioner alternatively relies on Uemura or Abe as the primary reference for independent claims 1 and 5, and additional references for certain dependent claims. Petitioner's grounds against the only independent claims of the '641 Patent (claims 1 & 5) are predicated solely on Uemura and Abe (i.e., grounds 1, 2, 5, 6); and Petitioner does not rely on any other reference in connection with its grounds against the independent claims. For purposes of this response, Patent Owner addresses only

the grounds directed to the independent claims and the references relevant to those grounds, Uemura and Abe. To the extent that those grounds fail, so do Petitioner's remaining grounds for the reasons given *supra*.

1. Uemura (Ex. 1009)

U.S. Patent Application No. 2002/0012830 to Uemura et al. ("Uemura") is titled "Rechargeable Lithium Battery" and describes a "rechargeable lithium battery includes a negative electrode material having a total irreversible capacity of 45% or less of a total capacity of a positive electrode material." Ex. 1009, abstract. Uemura teaches a "capacity balance ratio B/A of the total capacity B of the negative electrode material to the total capacity A of the positive electrode material." Ex. 1009, [0033]. The total capacity of the negative electrode (or "anode") material in Uemura includes "irreversible capacity" of the anode, and Figure 3 of Uemura provides a table comparing the composition of a positive electrode, the irreversible capacity of the negative electrode, and the number of cycles for various materials tested by Uemura. Ex. 1009, [0018]. Uemura teaches that it is beneficial to render a significant portion of the battery's capacity irreversible: "the total irreversible capacity of the negative electrode material should be fixed at a range of about 10% or more to about 45% or less, preferably about 20% or more to about 36% or less, of the total capacity of the positive electrode material." Ex. 1009, [0028].

Uemura teaches that negative electrode materials with larger irreversible

capacity than conventional negative electrode materials should be employed to improve the stability of the battery. Ex. 1009, [0024]. Specifically, “if the layered lithium manganese complex oxide with a large capacity but without sufficient structural stability is employed as a positive electrode material, the total irreversible capacity of the negative electrode material is adjusted so as to be larger than that of the conventional ones.” Ex. 1009, [0015]. Uemura further teaches that “the irreversible capacity of the negative electrode material determines a quantity of Li ions coming in and out of the positive electrode material.” *Id.* Thus, a PHOSITA would understand that increasing the total irreversible capacity of the negative electrode material would reduce the lithium ions “coming in and out of the positive electrode material.” *Id.*

In this context—of increasing the *irreversible* capacity of the anode and *reducing* the amount of lithium ions in circulation—Uemura teaches range of negative to positive electrode capacity between 1-1.5, without however disclosing the voltage at which this ratio is measured or designed for. Ex. 1009, [0033].

Uemura also discloses a voltage range—under constant current conditions—that partially overlaps with the claimed charge cut-off voltage range in the patent:¹

¹ For purposes of this preliminary response, Patent Owner takes no position as to whether any value of the range disclosed in Uemura is a charge cut-off voltage.

The charge-discharge was repeatedly performed at a constant current of 0.5 mA/cm and a voltage ranging from 4.3 V to 2.0 V at an atmospheric temperature of 60° C. by the use of the made sealed type non-aqueous solvent battery cell. Ex. 1009, [0081].

Uemura does not on its face require that a battery be charged to the upper boundary of this range or provide any other disclosure of a voltage above 4.2V. Also, Uemura does not teach applying a voltage for the purpose of increasing the amount of lithium ions and therefore the battery's overall capacity. Contrary to the '641 Patent—which seeks to increase the amount of lithium ions that shift between the anode and the cathode at each charge cycle ('641 Patent, 4:57-5:18)—Uemura seeks to reduce the amount of lithium ions that will shift between the cathode and anode in repeated charge-discharge cycles, including by increasing the total irreversible capacity of the anode.

2. Abe (Ex. 1005)

Japanese Patent Application Publication No. JP10189052 to Abe et al. ("Abe") is titled "Non-aqueous electrolyte-based secondary battery" and describes a "non-aqueous electrolyte-based secondary battery having a high electrical conductivity of the electrode itself, excellent cycle characteristics, and good stability against higher loads, that is, a non-aqueous electrolyte-based secondary battery having a high capacity even with charging and discharging at a high current value." Ex. 1005, [0017].

Abe discloses that “[t]he charge capacity is the amount of charge until a predetermined voltage is reached” and that “at the positive electrode, the voltage is set to a range at which no electrolyte decomposition occurs, and no irreversible structural breakdown of the positive electrode active material occurs.” Ex. 1005, [0078]. Further, Abe provides the following ranges of upper voltage values at which “no electrolyte decomposition, and no structural breakdown of the positive electrode active material occurs” for potential exemplary cathode materials: “[f]or example, LiMn_2O_4 is 4.2-4.3 V, preferably 4.2 V, and LiCoO_2 and LiNiO_2 are 4.1-4.2 V, preferably 4.1 V.” *id.*

The first of these ranges only partially overlaps with the claimed charge cut-off voltage range in the '641 Patent, *i.e.*, greater than 4.2V and less than 5.8V. Abe teaches preferably selecting voltages up to or below 4.2V and provides the following warning, which teaches against the claimed charge cut-off voltage range:

“Incidentally, in general, in the case of overcharging lithium-ion secondary batteries or when the charging current is increased, etc., needle-like lithium may be precipitated on the surface of the negative electrode, interposed between the positive electrode and the negative electrode, making it easier to break through the separator and short out. As a result, lithium-ion secondary batteries may also explode and ignite.” Ex. 1005, [0005].

III. CLAIM CONSTRUCTION

A. Claim 1: Preamble

To the extent Petitioner argues that “Claim 1 purports to be a method claim yet it has no steps” (Pet., 8), the IPR statute does not authorize the Board to cancel challenged claims for indefiniteness. *Samsung Elecs. Am., Inc. v. Priusa Eng’g Corp.*, 948 F. 3d 1342, 1350 (Fed. Cir. 2020). As Petitioner admits, the Board can address the prior art challenge to claim 1 without addressing indefiniteness. *Intel Corp. v. Qualcomm Inc.*, 21 F. 4th 801, 814 (Fed. Cir. 2021).

B. Claims 1 & 5: “capacity ratio range” limitations²

For the purposes of this preliminary response, Patent Owner takes no position on Petitioner’s proposed constructions of “ratio of positive electrode material to negative electrode material as calculated by a theoretic capacity with a charge cut-off voltage set at 4.2 V” and “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

² Claim 5 recites a “ratio of positive electrode material to negative electrode material as calculated by a theoretic capacity with a charge cut-off voltage set at 4.2 V.” Claim 1 recites “a ratio of positive electrode material to negative electrode material of the secondary lithium-ion cell or battery is from 1:1.0 to 1:2.5 as calculated by a specific capacity with a charge voltage limited to 4.2 V.”

as calculated by a specific capacity with a charge voltage limited to 4.2 V.” The Board therefore need not construe these terms. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (noting that the Board need only construe terms “that are in controversy, and only to the extent necessary to resolve the controversy”).

C. Claim 11: “at least 7500 of capacity”

Patent Owner agrees that “at least 7500 of capacity” is a typographical error that should be read as “at least 75% of capacity.”

D. All Claims: “charge cut-off voltage”

Patent Owner takes no position at this time as to the appropriate construction of “charge cut-off voltage,” other than to state that the term “charge cut-off voltage” should be construed as “the charge cut-off voltage of a full-cell (two-electrode) system.”³

The ’641 Patent consistently describes systems with two electrodes (a positive electrode and a negative electrode) and adjusting the ratio of electrode material based on the voltage between the two electrodes. *See, e.g.*, ’641 Patent, 3:7-11 (“the

³ Patent Owner reserves the right to raise arguments at a later stage, if needed, based on the construction of charge cut-off voltage applied by the Eastern District of Texas in the parallel litigation.

efficacy of electrode active materials is greatly increased by increasing the charge cut-off voltage and property [sic] *adjusting the ratio of positive electrode material to negative electrode material of single lithium ion cell.*”) (emphasis added).

This is further supported by the discussion of the properties of two electrodes at a charge cut-off voltage of 4.2 V, in particular, the properties of the positive electrode ('641 Patent, 8:5-41) and of the negative electrode ('641 Patent, 8:49-9:55) at that cut-off voltage. Critically, the '641 Patent nowhere mentions a battery having a third electrode or the possibility of adapting the disclosed battery to include such a third electrode (which would be needed to determine the voltage of only one of the positive or negative electrode, as disclosed, for example, in Abe). Accordingly, the “charge cut-off voltage” in the '641 Patent is the charge cut-off voltage measured for the disclosed full-cell voltage two-electrode system, not an undisclosed three-electrode half-cell voltage system.

Patent Owner reserves its right to dispute Petitioner’s constructions and to construe additional terms in this or other proceedings involving the '641 Patent.

IV. PERSON OF ORDINARY SKILL IN THE ART

Petitioner states that the “person having ordinary skill in the art (‘PHOSITA’) would have had a Master’s degree in material science, chemical engineering, chemistry, or similar field with four years of experience designing testing, and building secondary lithium batteries.” Paper 1, 11. “More experience can substitute

for less education and vice-versa.” Paper 1, 12.

For purposes of this Preliminary Response only, Patent Owner does not dispute Petitioner’s definition, except noting that other majors may provide equivalent education and experience designing, testing, and building lithium batteries.

V. PETITIONER’S ANTICIPATION GROUNDS FAIL

Petitioner asserts two anticipation grounds against the two independent claims in the ’641 Patent (claims 1 & 5) on the basis of two references: Uemura (Ground 1) and Abe (Ground 5). Paper 1, 7. “Anticipation requires that a single prior art reference disclose each and every limitation of the claimed invention, either expressly or inherently.” *SRI Int’l, Inc. v. Cisco Systems, Inc.*, 930 F.3d 1295, 1306 (Fed. Cir. 2019). As discussed below, both of Petitioner’s anticipation grounds fail because Uemura and Abe fail to disclose one or more of the claimed charge cut-off voltage and capacity ratio ranges, expressly, inherently, or with sufficient specificity (as required under Federal Circuit precedent concerning overlapping ranges).

A. Uemura fails to disclose the claimed capacity ratio range limitation either expressly or inherently.

Claims 1 and 5 recite a “ratio of positive electrode material to negative electrode material” that—among other limitations not addressed in this response—ranges “from 1:1.0 to 1:2.5” measured at “a charge cut-off voltage set at 4.2V.” Uemura does not disclose a capacity ratio measured at any voltage level, let alone

at 4.2V. Petitioner does not argue otherwise; thus, indisputably, Uemura does not expressly disclose the claimed capacity ratio range.

To overcome this lack of disclosure, Petitioner urges the Board to commit legal error with assertions that a PHOSITA “would have” known or understood that the Uemura battery’s capacity would have been measured at the charge cut-off voltage required under the ’641 Patent:

- “Uemura’s ratio *would have been understood to have been calculated at 4.3 V* (the charge cut-off voltage)”; Paper 1, 20.
- “a PHOSITA *would have understood* that Uemura’s ratio would remain within the range of the ’641 patent when determined at a charge cutoff voltage of 4.2V instead of 4.3V”; Paper 1, 20.and
- “*a PHOSITA would have known* that Uemura’s capacity balance ratio is determined at 4.3V because it is the ratio the battery is intended to operate at” Paper 1, 21.

Even assuming these assertions have merit (they do not), anticipation requires that “a single reference describe the claimed invention with sufficient precision and detail to establish that the subject matter existed in the prior art.” *Wasica Finance GmbH v. Continental Automotive Systems, Inc.*, 852 F.3d 1272, 1284 (Fed. Cir. 2017). Uemura’s high-level disclosures and Petitioner’s speculative assertions as to

how a PHOSITA might interpret them cannot substitute for the lack of detail and specificity required for anticipation by the Federal Circuit, which has held that “the Board [may not] fill in missing limitations even when a skilled artisan would immediately envision them.” *Nidec*, 868 F.3d at 1274–75.

Indisputably, Uemura is missing the claimed capacity ratio limitation; and Petitioner is asserting that a PHOSITA reading Uemura *might* measure the capacity ratio at the voltage required in the ’641 patent by performing a number of inferential leaps. These are precisely the types of gymnastics which the Federal Circuit has admonished are not permitted in the context of evaluating whether a reference anticipates where it does not expressly disclose a limitation; and Uemura—indisputably—is such a reference. For example, Uemura discloses experiments performed at a broad range of voltages—between “4.3 to 2.0V” (Ex. 1009, [0081])—without any guidance as to the voltage within that range for which a PHOSITA should or should not measure or design the capacity ratio. In other words, Uemura permits a PHOSITA to practice a battery with a capacity ratio measured at any reasonable voltage level within its disclosed voltage range; and Uemura is silent—or at the very least *ambiguous*—as to what that capacity ratio or voltage level are. Thus, Uemura cannot anticipate the claimed capacity ratio range because the law is clear that “ambiguous references do not, as a matter of law, anticipate a claim.” *Wasica*, 853 F.3d at 1284.

Further, though it does not appear that Petitioner is arguing that 4.3V or 4.2V is inherently the voltage level at which the capacity ratio of the Uemura battery would be measured/designed for, to the extent that Petitioner were arguing anticipation by inherency, such an argument would likewise fail. Petitioner has not asserted (let alone established) that 4.3V is *necessarily* the voltage at which the missing capacity ratio would be measured under Uemura. At most, Petitioner has argued that a PHOSITA *might* measure/design the capacity close to the upper boundary of Uemura's voltage range between 4.3-2.0V. The law is clear, however, that "[t]he possibility of such [a measurement] does not suffice to show anticipation" because "[o]ccasional results are not inherent." *MEHL/Biophile Intern. Corp. v. Milgraum*, 192 F.3d 1362, 1365 (Fed. Cir 1999) (holding that the possibility of aligning a laser disclosed in a manual over a hair follicle was insufficient to anticipate a claim directed to laser alignment "substantially vertically over a hair follicle opening.").

Accordingly, Uemura fails to disclose the claimed capacity ratio range either expressly or inherently, as would be required for anticipation.

B. Abe fails to disclose the claimed voltage range either expressly or inherently.

Independent claims 1 and 5 recite a secondary lithium ion or cell with a charge cut-off voltage "greater than 4.2 V but less than 5.8 V." Abe discloses that in a three-

electrode system (“triode”), it is preferable to set the voltage at the positive electrode at 4.2V (outside the claimed range) and that 4.2-4.3V is the voltage at which electrolyte decomposition does not yet occur (or stated otherwise, where such decomposition may begin to occur) for a particular type of electrolyte:

- The charging capacity can be obtained, for example, by continuously recording a voltage that changes over time by applying a constant current *using a three-electrode cell* in which both the counter and the reference pole are made of metal lithium.
- *In the triode cell*, the starting voltage when using a vapor-phase-grown carbon fiber negative electrode as the working electrode is 3 V, and the charge (applying current from the working electrode to the counter electrode) proceeds and decreases toward 0 V. When a positive electrode is used for the working electrode, the voltage at the start is the potential difference between the metal lithium and the positive electrode material, and the voltage rises with charging (applying current from the counter electrode to the working electrode).
- The predetermined voltage is 0 V at the vapor-phase-grown

carbon fiber negative electrode, and *at the positive electrode, the voltage is set to a range in which no electrolyte decomposition occurs, and no irreversible structural breakdown of the positive electrode active material occurs.* For example, LiMn_2O_4 is 4.2-4.3 V, *preferably 4.2 V*, and LiCoO_2 and LiNiO_2 are 4.1-4.2 V, preferably 4.1 V.

Ex. 1005, [0078]. Clearly, Abe discloses a voltage measured in a three-electrode cell (or the half-cell voltage of the positive electrode), measured from a third “counter electrode” to the positive electrode.

In contrast to the disclosure in Abe, the '641 Patent describes the “charge cut-off voltage” as the full cell voltage between the negative electrode and the positive electrode (measured between the negative electrode and positive electrode). '641 Patent, 3:7-11. Accordingly, because Abe discloses a voltage range in a different battery cell than that claimed in the '641 patent, Abe does not disclose the claimed voltage range, which is recited in the independent claims for a battery with two electrodes, not three. *Nidec Motor Corp.*, 851 F.3d at 1274 (holding that Board misapplied the skilled artisan “immediately envisioned” analysis and improperly “assumed disclosure of claimed element” that was not present in prior art system disclosing a signal in a “stationary frame of reference” where claimed signal was in a “rotating frame of reference.”).

C. Abe and Uemura fail to disclose the claimed ranges with sufficient specificity to anticipate.

Petitioner asserts that Abe and Uemura anticipate the independent claims of the '641 Patent in view of voltage and capacity ratio ranges disclosed in those references. As discussed in detail below, the disclosures in these prior art references are insufficient to anticipate the '641 Patent claims as a matter of law.

The law is clear that “[i]f the prior art discloses its own range, rather than a specific point, then the prior art is only anticipatory if it describes the claimed range with sufficient specificity such that a reasonable fact finder could conclude that there is no reasonable difference in how the invention operates over the ranges.” *Ineos USA LLC v. Berry Plastics Corp.*, 783 F.3d 865 (Fed. Cir. 2015). A claimed range is not anticipated by a prior art range where the “claimed range is critical to the operability of the invention and the range disclosed in the prior art [is] substantially different.” *Id.* (discussing *Atofina v. Great Lakes Chemical Corp.*, 441 F.3d 991 (Fed. Cir. 2006)). In *Atofina*, the prior art at issue disclosed a temperature range of 100–500 °C which encompassed the claimed range of 150-350 °C. Nevertheless, “the patent-in-suit was not anticipated because there was a considerable difference between the prior art’s broad disclosure and the claimed critical temperature range, such that no reasonable fact finder could conclude that the prior art describes the claimed range with sufficient specificity to anticipate this limitation of the claim.”

Ineos, 783 F.3d at 869. “Key to this conclusion was the fact that the evidence showed that a person of ordinary skill in the art would have expected the [reaction at issue in the patent] to operate differently, or not at all, outside of the temperature range claimed in the patent-in-suit.” *Id.*

As discussed in detail below, according to the opinions of Petitioner’s own expert, a PHOSITA would expect the claimed battery “to operate differently, or not at all, outside of the” claimed ranges, *i.e.*, that the claimed ranges fit the Federal Circuit’s legal definition of criticality. Given that the ranges in Abe and Uemura, at most, partially overlap with the claimed ranges, it would be legal error for the Board to find anticipation in this scenario. *See, e.g., UCB v. Actavis*, 65 F.4th 679, 689 (Fed. Cir. 2023) (Federal Circuit finding legal error where partially overlapping prior art range between 9:1.5-9:5 was found to anticipate claimed range between 9:4-9:6 without accounting for criticality of claimed range); *also OSRAM Sylvania, Inc. v. American Induction Technologies, Inc.*, 701 F.3d 698, 701 (Fed. Cir. 2012) (reversing a grant of summary judgment of anticipation where the patentee raised a genuine dispute of material fact showing that the claimed range limitation “was central to the invention claimed”).

1. Taking Petitioner’s Expert opinions at face value, the claimed ranges are critical

Independent Claims 1 and 5 recite ranges for a “charge cut-off voltage ...

greater than 4.2V but less than 5.8V” and for a “ratio of positive electrode material to negative electrode material” from “1:1.0 to 1:2.5 as calculated by a specific/theoretic capacity” with a charge cutoff voltage of 4.2 V. The ’641 patent teaches repeatedly that these ranges, applied in tandem, are essential to practicing a battery with “improv[ed] capacity, average operating voltage and specific energy” without the negative effects that were known and expected in the prior art at higher charge cut-off voltages:

- ***Contrary to the prior art, the charge cut-off voltage*** of the single cell of said secondary cell or battery ***is greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material*** calculated by the theoretical capacity under the charge cut-off voltage of 4.2 V ***is 1:1.0 to 1:2.5***. ’641 Patent, 7:24–30.
- As compared to the prior secondary lithium ion cell or battery cell, the capacity, energy density and output voltage of the present secondary lithium ion cell or battery are greatly improved, while its recycle life is equivalent to that of the prior art cell. ’641 Patent, 7:30–34.
- For achieving better effect, the aforesaid charge cut-off voltage

used in the present invention is preferably in the range from 4.3 V to 5.2 V, more preferably in the range from 4.3 V to 4.8 V. '641 Patent, 7:34–37.

- In addition, the ratio of positive electrode material to negative electrode material of said single lithium ion cell, which is calculated by the theoretical capacity under the charge cut-off voltage of 4.2 V, is 1:1.5 to 1:2.5. '641 Patent, 7:37–40.

The thrust of the invention thus lies in the teaching that: (i) substantially raising the charge cut-off voltage has certain performance benefits and (ii) doing so without sacrificing other key performance characteristics requires setting the capacity of the anode relative to that of the cathode in a corresponding, elevated range.⁴

According to Petitioner's expert, Dr. Juzkow, the claimed ranges are critical, consistent with the teachings on the face of the '641 Patent. With respect to the charge cut-off voltage, Dr. Juzkow opines that raising the cut-off voltage is necessary to increasing overall capacity because it "extract[s] more lithium ions:"

⁴ The patent teaches a ratio of the cathode to the anode capacity ranging from 1:1.00-1:2.5; and inverting that ratio shows that this means the anode capacity, at the boundary of that ratio is 2.5 times that of the cathode.

- “The capacity, however, increases when a higher charge cutoff voltage is applied.”
- Those knowledgeable about secondary lithium-ion batteries were aware that *applying additional voltage would extract more lithium ions* from the cathode than a lower voltage. Juzkow Decl. at 17.

Dr. Juzkow thus confirms that a PHOSITA would expect that a battery would operate differently if it were charged to a lower voltage than the claimed voltage range, *i.e.*, that the claimed voltage range is critical. *Compare with Ineos*, 783 F.3d at 869.

Further, with respect to the claimed capacity ratio range, Dr. Juzkow opined that higher voltages have undesirable effects, which could be addressed by increasing the capacity of the anode relative to the cathode (*i.e.*, what the '641 Patent teaches):

- [A]dditional lithium is extracted from the positive electrode at higher voltages[, and] the plating of metallic lithium on the negative electrode was undesirable. Ex. 1002, ¶17.
- “[T]he negative electrode should have at least as much capacity as the positive electrode[.]” Ex. 1002, ¶21.

Dr. Juzkow thus confirms that a PHOSITA would expect that a battery would operate differently if its anode capacity were not adjusted in a capacity ratio range that corresponds to the claimed voltage range, as taught in the '641 Patent, *i.e.*, that the capacity ratio range is likewise critical. *Compare with Ineos*, 783 F.3d at 869.

Moreover, Dr. Juzkow opines that a capacity ratio of 1.5 is sufficient for the battery in Uemura and that it should not exceed that level:

- If the capacity balance ratio B/A exceeds 1.5, negative electrode sites that do not contribute to the charge-discharge are increased, leading to the wasteful use of materials. (Ex. 1002 at fn. 188) (quoting Uemura)

Given that Uemura's battery voltage, at most, only partially overlaps with the claimed charge cut-off voltage, Dr. Juzkow's opinion confirms that the higher voltage levels in the claimed range would also require higher anode capacity levels than the highest anode capacity disclosed in Uemura and Abe.⁵ Taken at face value, Dr. Juzkow's opinions confirm the criticality of the portion of the claimed capacity ratio range that is indisputably *undisclosed* by Abe and Uemura.

⁵ Abe discloses a maximum capacity of 1.6, which is similar to Uemura, at voltage levels that—as with Uemura—at most partially overlap with the claimed range.

In sum, there is no question that Petitioner's own expert emphasizes that the claimed ranges are critical according to the Federal Circuit's definition of criticality and Petitioner's own expert; thus, as also explained below, the partially overlapping ranges in Abe and Uemura cannot anticipate the independent claims as a matter of law.

2. Abe does not describe the claimed charge cut-off voltage range with sufficient specificity.

Independent claims 1 and 5 recite a secondary lithium ion or cell with a charge cut-off voltage "greater than 4.2 V but less than 5.8 V." The disclosure on which Petitioner relies for this limitation reads as follows:

- The predetermined voltage is 0 V at the vapor-phase-grown carbon fiber negative electrode, and at the positive electrode, the voltage is set to a range in which no electrolyte decomposition occurs, and no irreversible structural breakdown of the positive electrode active material occurs. For example, LiMn_2O_4 is 4.2-4.3 V, preferably 4.2 V, and LiCoO_2 and LiNiO_2 are 4.1-4.2 V, preferably 4.1 V. Ex. 1005, [0078].

Setting aside for present purposes that Abe's disclosure is for a three-electrode battery system—and assuming that Abe discloses a cut-off voltage range between 4.2-4.3V, as Petitioner asserts—no reasonable factfinder would find the range in Abe

to anticipate the claimed charge cut-off voltage range, which is “greater than 4.2V but less than 5.8V” because, as discussed above, the claimed range is critical according to Petitioner’s expert.

Further, Abe teaches that 4.2-4.3V is a voltage range in which “no electrolyte decomposition occurs” accompanied by “irreversible structural breakdown of the positive electrode active material” and the maximum voltage is “preferably 4.2V.” Thus, on its face, Abe does not instruct setting the charge cut-off voltage in a range between 4.2-4.3V, only that doing so would approach the critical threshold of electrolyte decomposition, and that 4.2V is therefore a preferable value that avoids this harmful effect. In other parts, Abe teaches that what it calls “overcharging” a secondary lithium-ion battery could lead to a number of dangerous side effects, including the reduction of cycle life and even ignition or explosion. Ex. 1005, [0009]. Thus, incontrovertibly, Abe teaches that a battery would operate differently or not at all within the elevated, claimed range. Accordingly, Abe does not anticipate on the basis of the disclosure of a partially overlapping range of 4.2-4.3V.

3. Abe does not describe the claimed capacity ratio range with sufficient specificity.

As discussed above, independent claim 1 and claim 5 recite a “ratio of positive electrode material to negative electrode material” from “1:1.0 to 1:2.5 as calculated by a specific/theoretic capacity” with a charge cutoff voltage of 4.2 V.

Petitioner asserts that Abe anticipates this range on the basis of the following disclosures in Abe:

- In a non-aqueous electrolyte-based secondary battery according to the present invention, the design capacity of the negative electrode is adjusted so that the design capacity of the negative electrode is greater than the design capacity of the cathode. Ex. 1005, [0078].
- [A battery with a] negative electrode ... “having a design capacity of more than 1 and less than or equal to 1.6 for the design capacity of the positive electrode.” Ex. 1005, [0018].

Even assuming for purposes of this Response that the “design capacity” in Abe is the same as “specific capacity” recited in claim 1 and the “theoretic capacity” recited in claim 5 (it is not), neither range is described with sufficient specificity such that a reasonable fact finder could conclude that there is no reasonable difference in how the invention operates over the ranges. *Atofina*, 441 F.3d at 999.

First, Abe does not disclose the charge cut-off voltage used for the calculation of the “design capacity” ratio. Rather than pointing to such a disclosure, Petitioner asserts that for LiMn_2O_4 , the capacity would be “determined at a voltage, for example, between 4.2 V and 4.3 V.” Paper 1, 37. But this assertion is directly

contradicted by Abe itself. Even assuming the 4.2–4.3V voltage range denotes a range of charge cut-off voltages (it does not), Abe does not disclose charging the battery of Embodiment 2—*i.e.*, the battery that uses LiMn_2O_4 as the positive electrode material in the example in question—to a charge cut-off voltage ranging from 4.2 to 4.3 V. Rather, Abe discloses that the battery in Embodiment 2 is charged and discharged with a constant current in the range of “2.5 to 4.1 V.” Ex. 1005, [0097], [0104]. And in any event, Petitioner’s own expert establishes that the claimed capacity ratio range operates in tandem with the charge voltage range and, thus, in addition to being critical in and of itself (according to Dr. Juzkow), is critical over the claimed charge cut-off voltage range. Accordingly, Abe disclosures of capacity ratio ranges fail to anticipate the claimed capacity ratio range.

In any event, similar to Uemura (discussed *supra*), Abe fails to disclose the charge cutoff voltage at which the “design capacity” is measured, which makes Abe’s disclosure of a capacity ratio range ambiguous. Accordingly, for this additional reason, Abe does not anticipate as a matter of law.⁶

⁶ Petitioner also relies upon the 1:1.1 ratio disclosed in Embodiment 2 of Abe. But Embodiment 2 is charged and discharged between 2.5 V and 4.1 V using a constant current (Ex. 1005, [0097], [0104]), not a charge cut-off voltage equal to or higher

4. Uemura does not describe the claimed charge cut-off voltage range with sufficient specificity.

Petitioner also mistakenly asserts that Uemura anticipates because “Uemura’s secondary lithium-ion battery has a charge cutoff voltage greater than 4.2V but less than 5.8V—and specifically 4.3V.” Paper 1, 17. Petitioner relies on Uemura’s disclosure of experiments in which “[t]he charge-discharge was repeatedly performed at a constant current of 0.5 mA/cm² and a voltage ranging from 4.3 V to 2.0 V[.]” Ex. 1002, ¶113.

Uemura’s disclosures fail to anticipate as a matter of law. As an initial matter, Petitioner—and its expert Dr. Juzkow—fail to provide any evidence or explanation as to why a PHOSITA would understand Uemura’s disclosure of a charging range between “4.3V to 2.0V” necessitates that a PHOSITA would in fact charge the battery in Uemura up to 4.3V. Uemura’s disclosure—on its face—appears to allow a PHOSITA to charge a battery at any voltage within the recited range but nowhere appears to *require* charging (or cutting off charging) at the upper boundary of that range (or in any event above 4.2V) as would be required to overlap with the claimed voltage range, which is “greater than 4.2V.” Uemura is thus ambiguous as to

than 4.2 V. Accordingly, the 1:1.1 ratio disclosed in Abe likewise does not anticipate the claimed capacity ratio range, which is measured at 4.2V.

whether the upper boundary of its recited range is (i) the actual “charge cut-off” of a particular battery as Petitioner asserts (and must assert to anticipate) or (ii) simply a *potential* maximum value in a set of experiments that a PHOSITA may or may not follow (e.g., Uemura discloses charging at a “constant current” (Ex. 1009 at [0081]) the import of which Dr. Juzkow and Petitioner fail to address anywhere in their papers). For this reason—and given that Petitioner has not offered any explanation that would even purport to resolve this ambiguity—Uemura cannot anticipate as a matter of law. *See Wasica*, 852 F.3d at 1284.

Further, even assuming a PHOSITA would understand that the upper boundary of Uemura is one possible value of a charge cut-off voltage, such a disclosure still is insufficient to anticipate the claimed charge cut-off voltage range, given that, as discussed above, the claimed range is critical, and Uemura—at most—discloses only a partially overlapping range.

Accordingly, Uemura does not describe the claimed voltage range with specificity, and for this additional reason does not anticipate.

5. Uemura does not describe the claimed capacity ratio with sufficient specificity.

Petitioner asserts that “Uemura’s capacity balance ratio of 1 to 1.5 (*i.e.*, 1:1 to 1:1.5) as determined at 4.3V overlaps with and discloses a capacity balance between 1:1 and 1:2.5 determined with a charge cut-off voltage of 4.2V” (Paper 1, 26) on the

basis of the following disclosures (as described by the petition):

- [A] capacity balance ratio B/A of the total capacity B of the negative electrode material to the total capacity A of the positive electrode material is preferably fixed at a range of 1 to 1.5. (Ex. 1009, [0033])⁷

Petitioner's assertion is misplaced.

As an initial matter, as already discussed *supra* (in V.A), Uemura fails to disclose the claimed capacity ratio either expressly or inherently because it fails entirely to disclose the voltage for which the Uemura capacity ratio is designed or determined.

Further, even assuming that Uemura's capacity ratio range overlapped with the claimed capacity ratio range, Uemura would still not anticipate as a matter of law. As discussed *supra*, slightly overlapping ranges cannot anticipate critical claimed ranges; and here, Petitioner's expert has confirmed the criticality of the claimed range, and Uemura's capacity ratio range overlaps only slightly (if at all) with the claimed capacity ratio range. In such instances, the Federal Circuit has

⁷ Capacities are also shown in Table 3 of Uemura (*id.* at Table 3) for a number of experiments conducted in Uemura, though there is no disclosure as to the voltage at which those capacities were measured, *see supra* at V.A.

made clear that a finding of anticipation would constitute legal error. *See supra*. Accordingly, for this additional reason, Uemura does not anticipate claims 1 and 5.

VI. PETITIONER’S OBVIOUSNESS GROUNDS FAIL.

Petitioner asserts two obviousness grounds (Grounds 2 and 6) against independent claims 1 and 5, based on the same references as those which Petitioner asserts with respect to its anticipation grounds: Abe and Uemura. As discussed in Section V *supra*, Uemura and Abe do not expressly or inherently disclose the claimed charge cut-off voltage and capacity ratio ranges; Abe and Uemura thus do not anticipate. To show obviousness, Petitioner must articulate some rationale as to why a PHOSITA would have adapted the batteries disclosed in Uemura (with respect to Ground 2) and Abe (with respect to Ground 6) to practice the claimed ranges. *In re Stepan, Co.*, 868 F.3d 1342, 1346 (Fed. Cir. 2017 (requiring “some rational underpinning explaining why a person of ordinary skill in the art would have arrived at the claimed invention.”)); *see also*, MPEP § 2143. Neither Abe nor Uemura contain such a rationale or motivation.

A. Uemura and Abe teach against adapting Uemura and Abe to practice the claimed charge cut-off voltage ranges.

Both Uemura and Abe teach against raising the maximum charging voltage of a lithium-ion battery. For example, Abe expressly teaches that what it calls “overcharging” may cause structural damage to the battery so severe as to lead to ignition or explosion:

- Incidentally, in general, in the case of overcharging lithium-ion secondary batteries or when the charging current is increased, etc., needle-like lithium may be precipitated on the surface of the negative electrode, interposed between the positive electrode and the negative electrode, making it easier to break through the separator and short out. As a result, lithium-ion secondary batteries may also explode and ignite. Ex. 1005, [0005].

Likewise, Uemura teaches that it is desirable to reduce the amount of lithium ions in circulation in the battery because it improves the battery's operational characteristics:

- Specifically, *making the positive ions deficient* at the same time selecting a regular quantity of substituted elements *can lessen distortion or strengthen the chemical bond to stabilize the crystal structure*. If such a complex oxide designed under the guideline is employed as a positive electrode active material, reaction with an electrolytic solution during the charge-discharge can be suppressed *and cyclic stability, durability and stability of the rechargeable lithium battery can be improved*. Ex. 1005, [0040].

As Dr. Juzkow opines, the amount of lithium extracted from the positive electrode increases with higher voltages:

- [A]dditional lithium is extracted from the positive electrode at higher voltages[, and] the plating of metallic lithium on the negative electrode was undesirable. Ex. 1002, ¶17.
- Those knowledgeable about secondary lithium-ion batteries were aware that applying additional voltage would extract more lithium ions from the cathode than a lower voltage. *Id.*

Uemura and Abe therefore teach against increasing the battery's charge cut-off voltage, as doing so would also increase the amount of lithium extracted from the cathode, the opposite of Uemura's stated objective, and would increase the likelihood of the battery "short[ing] out" according to Abe.

There is nothing surprising about these teachings in Uemura and Abe against increasing a battery's charge cut-off voltage, as the prior art is replete with cautions against increasing the charge cut-off voltage above 4.2V. Indeed, several references cited by Dr. Juzkow contain cautions of this sort. For example, Watanabe states that when excess "charging voltage" is applied "lithium ions in the positive electrode are excessively extracted" thus causing "absorption of lithium in an amount larger than the prescribed design capacity in the negative electrode or to cause precipitation of

lithium as metallic lithium on the surface of the negative electrode.” Ex. 1019, [0005]. Iwaizono states that when the battery voltage exceeds 4.5 V, the battery temperature begins to rise sharply, leading to generation of undesirable gas by electrolyte decomposition. Ex. 1007, 11:4-7, 1:11-14. Others in the field repeatedly recognized the dangers of applying a higher charge cut-off voltage than 4.2V. For example, Love et al. states that common batteries have “an upper limit of 4.2V [and] charging above the voltage limit, or overcharging, destabilizes the cathode and causes thermal runaway and fires, thus presenting a significant challenge in battery safety.” Ex. 2001.

There is, in short, overwhelming evidence of concerns regarding safety, performance loss, and shorting out the battery associated with increasing the charge cutoff voltage, that would have prevented a PHOSITA from even attempting to practice the claimed voltage range, let alone engage in the complex process of adapting the capacity ratios taught by the '641 Patent and allegedly disclosed in the Uemura and Abe batteries to practice charge cut-off voltage values that are nowhere disclosed in those references.

Uemura and Abe are entirely consistent with the concept of reducing—and not increasing—the charge cut-off voltage (which was known in the art to have an upper limit of 4.2V). Though Abe and Uemura do not teach a specific cut-off voltage (and certainly not a design voltage above 4.2V), both teach against excess lithium

extraction that comes with higher charging. That they contain passing references to a voltage value equal to 4.3V does not imply that they make such a voltage (let alone a range higher than that value) obvious to a PHOSITA as the actual charge cut-off voltage of a battery. First, as explained in detail *supra* in Section V, Abe and Uemura's brief and ambiguous references to 4.3V do not disclose with any specificity or detail a cut-off voltage that corresponds to the claimed charge cut-off voltage range. Second, the context in which those passing references are made—*i.e.*, teachings in Abe, Uemura, and a host of other prior art literature advising against higher charge cut-off voltage values—would prompt a PHOSITA to avoid adapting Uemura and Abe to practice the claimed charge cut-off voltage range. Third, other than the passing references to an isolated value of 4.3V—which would only scratch the surface of the claimed range if it were at all relevant to it (and it is not)—there is ***no disclosure whatsoever*** in Uemura or in Abe that would prompt a PHOSITA to adapt the prior art batteries in those references to practice the claimed charge cut-off voltage ranges.

Further, Petitioner's expert opines that a PHOSITA would have known to ***regulate*** the charge voltage to avoid the problems described in the art, not ***increase*** the voltage for the purpose of increasing overall capacity as taught by the '641 Patent:

- *One known solution to this problem [i.e., “extraction of more lithium from the positive electrode”] was to alter how the charging of the battery was accomplished to regulate the voltage thus ensuring that too much lithium would not be extracted from the positive electrode material.* For instance, U.S. Patent No. 5,618,640 explains: metallic lithium is sometimes precipitated on the carbonaceous material *at the time of an overcharge* or a rapid charge. It eventually follows that lithium grows dendritically thereon. *This problem has been dealt with by altering a charger or reducing the amount of positive electrode active material to prevent an overcharge.* Ex. 1002, ¶27.

The prior art solution of keeping the voltage in check—which is consistent with Uemura and Abe’s teachings against applying high charging voltages and excess lithium extraction—are the opposite of the inventive concept taught by the ’641 patent, *i.e.*, substantially increasing the voltage and amount of lithium-ions extraction while substantially increasing capacity to levels undisclosed by either Abe or Uemura.

Lastly, with respect to Abe’s disclosure of a three-electrode system (of half-cell battery discussed *supra* in Section V.B), Petitioner has not advanced any argument as to why a PHOSITA would be motivated to adapt Abe’s system to

practice the claimed voltage range in the '641 Patent's two-electrode (or full-cell battery); Abe thus fails to render the claims obvious for this additional, separate reason.

Accordingly, given that Uemura and Abe (i) fail to disclose the claimed charge cut-off voltage range, (ii) teach against that range, (iii) and fail to otherwise suggest adapting the prior art batteries to practice that range, the Board should find that Uemura and Abe fail to render the claimed charge cut-off voltage range obvious and decline to institute review on the basis of Petitioner's obviousness grounds.

B. Uemura and Abe teach against adapting Uemura and Abe to practice the claimed capacity ratio range

As discussed *supra*, Abe and Uemura fail to disclose the claimed capacity ratio range either expressly or inherently. Thus, Petitioner bears the burden to show that Abe and Uemura contain a disclosure that would motivate a PHOSITA to adapt the batteries disclosed in those references to practice the claimed capacity ratio range. Neither Uemura nor Abe contain such disclosures. If anything, Uemura, Abe, and the prior art writ large teach against adapting the battery capacities in Uemura and Abe to increase anode capacity, as would be required to practice the claimed capacity ratio range.

First, Uemura teaches that increasing anode capacity beyond what is needed for the "charge-discharge" leads to "the wasteful use of materials." (Ex. 1002 at fn.

188) (quoting Uemura). Uemura thus teaches against the elevated anode capacity levels of the '641 Patent.⁸ Second, to the extent that the Petition suggests (incorrectly) that a PHOSITA seeking to design a battery with a higher charge cut-off voltage would have been motivated to increase anode capacities, both Uemura and Abe teach against higher charge cut-off voltages. Thus, even under the Petition's own, flawed, assumptions, Uemura and Abe teach against adapting their batteries by increasing anode capacity. Third, Petitioner has failed to identify a single reference containing a disclosure that would otherwise motivate a PHOSITA to adapt the ranges in Uemura and Abe to practice the claimed capacity ratio ranges for the purpose of raising the charge cut-off voltage.

Accordingly, Abe and Uemura fail to render obvious the claimed capacity ratio range; and the Board obvious and decline to institute review on the basis of Petitioner's obviousness grounds for this additional reason.

C. Uemura and Abe teach against adapting Uemura and Abe to practice the claimed charge cut-off voltage range and capacity ratio range in tandem as claimed.

Finally, as discussed in Section I, the independent claims recite the claimed

⁸ To be clear, Patent Owner does not adopt the teachings in Uemura against "wasteful use of materials;" but those teachings are relevant to how Uemura would teach a PHOSITA against practicing the higher anode capacity taught by the '641 Patent.

voltage range and claimed capacity ratio range *in tandem*—that is, the claims specify a charge cut-off voltage (“*greater than 4.2 V*”) that is *higher than* the charge voltage for the ratio of positive electrode material to negative electrode material (“as calculated...with a charge voltage *limited to 4.2V*”). Contrary to what is recited in the claims, the Petition does not show how either Uemura or Abe suggests a charge cut-off voltage higher than the charge voltage for the ratio of positive to negative electrode material.

Instead, the Petition explicitly represents that a PHOSITA would understand these voltage values to be equal. For Uemura, the Petition states that the charge voltage and charge cutoff voltage are both equal to 4.3 V: “Uemura applies a charge cutoff voltage of 4.3V to the battery cell, cycling the battery from 4.3V to 2.0V...Uemura’s ratio would have been understood to have been calculated at 4.3 V (the charge cut-off voltage).... [A] PHOSITA would have known that Uemura’s capacity balance ratio is determined at 4.3V because it is the ratio the battery is intended to operate at.” Pet., 20-21. Likewise for Abe, the Petition represents that the charge cutoff voltage and design capacity voltage are equal: “[A] PHOSITA would have understood that *the “design capacity” was designed for a cutoff voltage of 4.3V because that is the cutoff voltage the battery is designed for.*” Pet., 37.

Setting aside for purposes of this argument that Petitioner’s erroneous assertions that Uemura and Abe disclose a charge cut-off voltage above 4.2 V (they

do not, as discussed throughout this Response), Petitioner's representations that the design capacity voltage is equal to the charge cut-off voltage plainly show that Uemura and Abe do not satisfy the claim's recital of a charge cutoff voltage that is higher than the charge cutoff voltage used to measure the ratio of positive to negative electrode material. Indeed, Petitioner's expert testimony explicitly states that the design capacity voltage and the charge cut-off voltage should be the same, and the art teaches away from a charge cut-off voltage higher than the design capacity voltage because it is "understood to be inadvisable and potentially dangerous":

Calculating the capacity ratio at the voltage that the battery is designed to operate at would have been advisable because it would have allowed the battery designer to ensure that there was sufficient negative electrode material to allow intercalation of the lithium ions extracted from the positive electrode without plating lithium metal and thus the deleterious formation of dendrites. ***Calculating a capacity balance*** (e.g., for the 1:1 ratio of Example 4) ***at a voltage less than the intended voltage would have resulted in an overcharge situation when the battery was charged to the intended voltage, which would have been understood to be inadvisable and potentially dangerous.*** And, calculating the capacity ratio at a voltage higher than that used to charge the battery could have led to an excessive use of negative electrode material, thus occupying more space than necessary in the battery. Therefore, it at the very least would have been obvious to determine the capacity ratio at a charge cutoff voltage of 4.3 V in the context of Uemura.

Ex. 1002, par. 132. This testimony cites to Abe, Uemura, and Iwaizono, all of which shows that the prior art consistently taught away from a charge cut-off voltage higher than the design capacity voltage. Thus, the independent claims are distinguishable over the prior art for the additional reason that they recite a charge

cut-off voltage (“greater than 4.2 V”) that is higher than the charge voltage for the ratio of positive electrode material to negative electrode material (“as calculated...with a charge voltage limited to 4.2V”).

VII. CONCLUSION

Given that Petitioner’s anticipation and obviousness grounds as to the independent claims (claims 1 & 5) based on Uemura and Abe fail, so do all other grounds that Petitioner advances with respect to each of the remaining claims, all of which depend from claims 1 & 5. Accordingly, for this reason and the foregoing reasons set forth in this response, Patent Owner respectfully requests that institution be denied.

Date: October 26, 2023

Respectfully submitted,

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CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME LIMITS

This Patent Owner's Preliminary Response ("POPR") consists of 10,193 words, excluding table of contents, table of authorities, certificate of service, this certificate, or table of exhibits. The POPR complies with the type-volume limitation of 14,000 words as mandated in 37 C.F.R. § 42.24. In preparing this certificate, counsel has relied on the word count of the word-processing system used to prepare the paper (Microsoft Word).

Dated: October 26, 2023

/Minghui Yang/
Minghui Yang
Counsel for Patent Owner

CERTIFICATE OF SERVICE

The undersigned hereby certifies that the following documents were served
by electronic service, by agreement between the parties, on the date below:

**PATENT OWNER'S PRELIMINARY RESPONSE
EXHIBIT 2001**

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