Yamaki's Preliminary Data Do Not Teach a Battery Configured to a CCV above 4.2V

Q. Are the failure modes that are relevant safety issues related to the charge cutoff voltage of a

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secondary lithium-ion battery?

A. Yes. The one I just described, lithium plating, typically occurs at higher voltages. Obviously, the active material ratios are very important there, which is the subject of this whole discussion. But yes, high voltages, a failure mode, and the resultant safety issues are related in that case.

Q. Aside from safety, what are the reasons for which a person of ordinary skill in the art might want to keep the charge cutoff voltage low?

A. Well, certainly the understanding of capacity and the change in capacity under different conditions and over time is important.

Q. What do you mean by that?

A. Well, at very high charge voltages, one would expect to have a shortened cycle life.

Q. And why would high voltages cause a shortened cycle life from an electrochemical perspective?

A. Well, I can offer some reasons. I'm not sure that it's an exhaustive list. But changes in the positive electrode material where internal crystal changes, a battery engineer might describe it as over-discharging and overcharging the positive electrode, would change the conductivity and the ability of that particular chemical to store lithium, so it will

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affect the capacity over time.

Q. What other reasons?

A. To avoid high voltage? Electrolyte breakdown is a well-known one. These cells all contain nonaqueous electrolytes and lithium salts. And lithium salt is the source of the lithium ions that carry the current internal to the cell. The organic solvents that carry those electrolyte salts are subject to breakdown at high voltage. And typically, the result of breakdown is either the formation of films on electrodes, which are not conductive, and the breakdown into gas like CO2.

Q. Could those issues also result in safety hazards?

A. They could. Venting is, broad terms, considered to be a safety issue. Most cells are designed to vent safely, but what they're venting is a flammable material, so it's considered a -- there's no explosion, there's not necessarily a fire, but venting a flammable gas is a safety issue. So yes, electrolyte breakdown and the formation of gases is related to safety considerations.

Ex. 2008 [Hruska Dep.] at 87:24-89:21; POR at 28; Sur-Reply at 1-2

Yamaki's Preliminary Data Do Not Teach a Battery Configured to a CCV above 4.2V

22 Q. And at what voltages would those issues begin
23 to become a concern for a battery designer?
24 A. Depends on the electrolyte, the salts, the
25 electrodes, the metals, the positive electrode, the

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1 carbons used in the negative. There's a wide range of
2 design considerations that will impact where, for
3 example, the electrolyte breakdown decides to occur.
4 Q. So there's a host of factors that might affect
5 the particular charge cutoff voltage at which all of
6 these issues might start to arise. Correct?
7 A. There is a host of factors that affects that,
8 yes.

Ex. 2008 [Hruska Dep.] at 89:22-90:8; POR at 28; Sur-Reply at 1-2

A POSITA Would Not Raise Sakamoto's Voltage Because Sakamoto Teaches against Voltages above 4.2V



129. Mr. Hruska ignores the teachings of Sakamoto. Sakamoto expressly teaches against having more lithium ions circulating in the battery.[105] Sakamoto states that the prior art approach was to have more cathode capacity or almost equal capacity. In that scenario, Sakamoto states that "deposit of lithium occurs on the negative electrode during overcharge."[106] A POSITA would understand that raising the charge cutoff voltage of a battery would increase the amount of lithium circulating in the battery, similar to adding more cathode active material to the battery. Sakamoto thus expressly teaches away from increasing the charge cutoff voltage of the battery.

POR at 13-15; Ex. 2007 [Yao Decl.], ¶129

A POSITA Would Not Raise Sakamoto's Voltage Because Sakamoto Teaches against Voltages above 4.2V

[0006]

[Problem to Be Solved by the Invention]

In this type of secondary battery, charge-discharge cycle performance has been considered important. Although the value of the required charge-discharge cycle performance varies depending on the type of device being used, one measure is maintaining 70% of the initial capacity after 300 cycles. However, in the method of setting the ratio of the amount of the active material in both electrodes so that the reversible capacities on the positive electrode side and the negative electrode side are substantially equal, the charge-discharge cycle performance is insufficient due to significant deterioration from charging and discharging. Also, if the reversible capacities of the positive and negative electrodes are approximately equal, deposit of lithium occurs on the negative electrode during overcharge. This increases the amount of passive lithium, and leads to a decrease in battery capacity and to deterioration in cycle characteristics. The present inventors have discovered that the

APPLE-1005 [Sakamoto], ¶6; POR at 17; Ex. 2007 [Yao Decl.], ¶¶71, 127

A POSITA Would Not Raise Sakamoto's Voltage Because Sakamoto Teaches against Voltages above 4.2V

[0016]

The batteries prepared in this manner were subjected to a charge-discharge cycle with a constant current/constant voltage of 400 mA, a charge upper limit voltage of 4.2 V, a charging time of 2.5 hours, a constant current of 400 mA, and a discharge final voltage of 2.7 V. Fig. 1 shows the cycle characteristics up to 300 cycles for Battery A with a reversible capacity balance of 0.94 and Battery D with a reversible capacity of 1.18. It is clear from Fig. 1 that a difference in capacity retention was observed depending on the reversible capacity balance of the negative electrode/positive electrode. Battery A with a reversible capacity balance of 0.94 fell below 70% after 300 cycles. Battery D with a reversible capacity balance of 1.18 remained above 70%. Battery B with a reversible capacity balance of 1.01 showed significant cycle deterioration similar to Battery A. Battery F and Battery G, which have a reversible capacity balance greater than 1.3, experience less cycle deterioration, but their capacities are lower after the initial cycle.

APPLE-1005 [Sakamoto], ¶16; POR at 17; Ex. 2007 [Yao Decl.], ¶72

Yamaki-Sakamoto Does Not Include Sufficient Data to Enable A POSITA to Form A Reasonable Expectation of Success



135. At the priority date, it was conventional wisdom to limit the charge cutoff voltage to 4.2V, so little research had been done to see if a method that could work for a lower voltage battery system could also work for a higher voltage battery system. Because of the lack of research in the area, a POSITA would not have had any expectation about what would happen when a conventional method used in a lower voltage battery system is applied to a higher voltage system. Experiments would be needed, and a POSITA could not form a reasonable expectation of success as to the outcome of those experiments based on the limited information in the prior art.

POR at 32-33; Ex. 2007 [Yao Decl.], ¶135

Yamaki-Sakamoto Does Not Include Sufficient Data to Enable A POSITA to Form A Reasonable Expectation of Success

Q. Let's say I'm trying to improve the capacity retention for a particular secondary lithium-ion battery after 200 cycles, and I make some tweak to my compensating battery. How would I know, if I'm a person of ordinary skill in the art, whether my tweak has actually led to an improvement in terms of capacity retention?

A. Through testing.

Q. Is there any other way?

A. There are -- well, I think you presented a

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scenario that I'm somewhat reluctant to accept. Nobody decides to, you know, change a cell's performance at 200 cycles if that same system, for example, caused disaster at 210 cycles. And so one would never look to test a very specific development like that.

Typically, let's say you're considering a new material and you say that this material might have an impact on the cycle life characteristics. I would start by quick cycling. What is the -- what's the initial capacity? What's the capacity in the first few days of testing? And it might be disastrous, or it might be equivalent to the original design, in which case you might then expand the testing.

Eventually, on any system, you would test it out to full failure and you would not stop at 100 or 10 or 200 or 400. You would test it completely.

But that's after, you know, sort of the predictive testing that you do in a new system.

POR at 27-28; Ex. 2008 [Hruska Dep.] at 53:16-56:5; Sur-Reply at 2-3

Yamaki-Sakamoto Does Not Include Sufficient Data to Enable A POSITA to Form A Reasonable Expectation of Success

Q. But back to my question. Is testing important in terms of determining the capacity retention of a battery after a certain number of cycles?

A. Yes, testing is important.

Q. Why?

A. Because it's the only way to obtain specific information. There's far too many things that you're

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trying to impact when you design a battery, dozens and dozens of things, so you can't modify one of those, for example, the cycle life characteristics, or the high temperature performance, or many other things. You can't change those in a vacuum. So testing is always important to understand the full impact of a new design. And you do it in the most time-efficient and resource-efficient method possible.

POR at 27-28; Ex. 2008 [Hruska Dep.] at 53:16-56:5; Sur-Reply at 2-3

Yamaki-Sakamoto Does Not Include Sufficient Data to Enable A POSITA to Form A Reasonable Expectation of Success

Q. And I asked you if testing was important in terms of determining the capacity retention of a battery after a certain number of cycles. Let me change that question a little bit.

If I'm designing a new battery, is testing important to make sure that it has the performance characteristics that I want it to have?

A. Yes. Testing is the only way to make sure that you've got all of the performance characteristics that you're looking for.

But you can't ever test -- the example I said was let's say you're trying to improve the high temperature performance. There may be a point where that high temperature performance has improved, but there may be a level of temperature at which it's disastrously bad so you look for ways to predict it.

You know, the phrase that I used to always

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teach engineers was be bold in the testing. You know, use some key tests to predict values so that you don't have to test every single temperature, every single current, every single set of pulse conditions. You need to minimize that to do development in a reasonable time.

POR at 27-28; Ex. 2008 [Hruska Dep.] at 53:16-56:5; Sur-Reply at 2-3

A POSITA Would Not Have a Reasonable Expectation of Success in Combining Yamaki-Sakamoto

In contrast, the invention of the present application stipulates that "the maximum potential of the positive electrode during charging is 4.4 V or more and 4.6 V or less based on metallic Li" as described above, so that a higher performance lithium secondary battery can be provided than before. Furthermore, there is no mention or suggestion in Reference 2 that "the maximum potential of the positive electrode during charging is 4.4 V or more and 4.6 V or less based on metallic Li" is a suitable voltage range that can provide a higher performance lithium secondary battery than conventional examples. As explained in paragraphs [0006] to [0009] of the invention of the present application, the technical environment for lithium secondary batteries in charging is completely different when the charging voltage is about 4.3 V or less and 4.4 V or more, so it is extremely difficult to predict the performance of lithium secondary batteries when the charging voltage is 4.4 V or more based on the performance when the charging voltage is about 4.3 V or less. In other words, we believe that it is difficult to derive the invention of the present application even if References 2 and 4 are combined.

Ex. 2019 [Yamaki File History] at 7; POR at 32-33; Sur-Reply at 4-5; Ex. 2007 [Yao Decl.], ¶136

A POSITA Would Not Have a Reasonable Expectation of Success in Combining Yamaki-Sakamoto



136. Moreover, the applicant of Yamaki demonstrates what a POSITA would have understood as the "fundamental" difference between Yamaki and Sakamoto.[115] As mentioned above, during prosecution, the applicant of Yamaki states that Yamaki's battery system is "fundamentally different" from a conventional 4.2V battery system, such that it is "extremely difficult" to predict performance at higher charging voltages based on performance at lower voltages. Yamaki purports to describe a battery system with higher voltages. In contrast, Sakamoto describes a method that allegedly works for the conventional 4.2V system. Mr. Hruska's opinion that combining Yamaki with Sakamoto is just an application of known techniques to an already-known system that would produce predictable results is therefore inconsistent with the record.[116] The remark from the applicant of Yamaki is further evidence demonstrating that a POSITA would not have been motivated to combine the two references with a reasonable expectation of success.

Ex. 2019 [Yamaki File History] at 7; POR at 32-33; Sur-Reply at 4-5; Ex. 2007 [Yao Decl.], ¶136

A POSITA Would Not Have a Reasonable Expectation of Success in Combining Yamaki-Sakamoto

"To be sure, to have a reasonable expectation of success, one must be motivated to do more than merely vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result, ***where the prior art gave either no indication of which parameter were critical or no direction as to which of many possible choices is likely to be successful***."



Pfizer, Inc. v. Apotex, Inc., 480 F.3d 1348, 1365 (Fed. Cir. 2007).

The Prior Art Does Not Teach an Interplay between the CCV and Capacity Ratio



the priority date, was focused on inventing a new electrode material. In contrast, capacity ratio was a design parameter that had long been overlooked as of and even many years after the priority date. Even Yasunami, which Petitioner asserts in this case, suggests that the ratio between the positive electrode active material and the negative electrode active material can be set "arbitrarily."[107] More than ten years after the priority date of the '641 Patent, commentators still suggested that the manner in which the capacity ratio affects battery performance was poorly studied.[108] Prior to the invention of the '641 Patent, no reference connected raising the charge cutoff voltage of a secondary lithium-ion battery with the capacity ratio in a particular range. This is demonstrated by the fact that none of Petitioner's references disclose these two parameters *in tandem* or even suggest that the ratio could allow raising the 4.2V traditional charge cutoff voltage limit.

Ex. 2007 [Yao Decl.], ¶130; Sur-Reply at 5-8; POR at 33-36

How Capacity Ratio Affects Battery Performance Was Not Well-Understood



49. The capacity ratio in lithium-ion batteries generally refers to the ratio of the capacities between the cathode (positive electrode) and the anode (negative electrode). As of the priority date of the '641 Patent, the capacity ratio was not the focus of battery designers and developers. Indeed, more than 10 years after the priority date of the '641 Patent, commentators still suggest that while "many researchers of electrode-design parameters have focused on individual electrodes such as cathode or anode, only limited works have been done for the parameter such as the capacity ratio of negative to positive electrode (N/P ratio)."[10]

Ex. 2028 [Kim 2015] at 1; POR at 11; Ex. 2007 [Yao Decl.], ¶49

Mr. Hruska Improperly Cherry-Picked Prior Art

"To often the obviousness analysis is framed as an inquiry into whether a [POSITA], with two (and only two) references sitting on the table in front of him, would have been motivated to combine … ***The real question is whether that skilled artisan would have plucked one reference out of the sea of prior art***."

WBIP, LLC v. Kohler Co., 829 F.3d 1317, 1337 (Fed. Cir. 2016).



Mr. Hruska Improperly Cherry-Picked Prior Art

Q. I'm not talking about Duracell now. Just more broadly, are you aware of examples in which batteries were designed with positive electrode capacity greater than negative electrode capacity?

A. I can't think of any, no. Certainly not lithium-ion systems. I mean, if you open it up to other secondary batteries, of course, that's a completely different case.

Q. Let's limit ourselves to just secondary lithium-ion batteries.

A. Okay.

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Q. Are you aware of any literature or patents or any other publications in which it is disclosed that batteries be designed with greater positive than negative electrode capacity?

A. I can't recall that, no. I can't think of any examples of that.

Ex. 2008 [Hruska Dep.] at 139:15-140:6; POR at 29-30; Sur-Reply at 5-8

Mr. Hruska Improperly Cherry-Picked Prior Art

Q. You can't explain why Ijiri here teaches that it's possible to set the negative electrode active material layer to 80 percent of the capacity of the positive electrode?

A. I don't know all the reasons Ijiri did this. Certainly not why he mentioned that range, no. I can't explain his disclosure.

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Ex. 2008 [Hruska Dep.] at 149:23-150:4; POR at 29-30; Sur-Reply at 5-8

Mr. Hruska Improperly Cherry-Picked Prior Art

26. First, any capacity balance between negative and positive electrode that is not an exact 1:1 balance will reduce the energy density relative to that 1:1 balanced battery. But this is true regardless of whether the balance is offset to favor the negative side (*i.e.*, more negative than positive capacity, as in Koyama) or the positive side (*i.e.*, more positive than negative capacity). In practice, there are also advantages to an off-balance capacity (in either direction) that can outweigh the reduction in energy density. For instance, as I discussed in my First Declaration, a 1:1 capacity ratio can give rise to safety issues, and instead using a capacity ratio that is off-balance in favor of the negative electrode reduces safety hazards (among other advantages). Yet other advantages are relevant when the capacity ratio is off-balance in favor of the positive electrode.

APPLE-1035 [Hruska Supp. Decl.], ¶26; Sur-Reply at 7 n.1

Outline

1. The ’641 Patent
2. Claim Construction: “charge cut-off voltage”
3. Claim 5 is not obvious over Yamaki and Sakamoto (Ground 1A - Claims 5-8 and 11-14; Ground 1B - Claims 9-10)
4. **Claim 5 is not obvious over Yasunami and Koyama (Ground 2A – Claims 5-14; Ground 2B – Claims 9-10)**
5. Neither of Petitioner’s combinations renders obvious claims 11-14 (Ground 1A; Ground 2A)

Yasunami Only Discloses an Applied Voltage

(0066) The resultant batteries were then subjected to a charge/discharge cycle test at a charging end voltage of 3.9 to 4.3 V and a discharging end voltage of 1.8 V with a current density of 2 mA/cm^2. The number of cycles required to attain 60% of the initial discharge capacity was deemed the charge/discharge cycle lifespan. For embodiment example 1 of the present invention, prior to charging, discharging was first performed to 0.5 to 1.5 V, after which charging was performed. In the comparative examples, discharging was either not performed prior to charging, or discharging was performed to a discharging end voltage either less than 0.5 V or greater than 1.5 V. The results are shown in TABLE 1.

Ex. 2030 [Yasunami], ¶66; POR at 50; Sur-Reply at 16

Yasunami Only Discloses Constant Current Charging

(0066) The resultant batteries were then subjected to a charge/discharge cycle test at a charging end voltage of 3.9 to 4.3 V and a discharging end voltage of 1.8 V with a current density of 2 mA/cm^2. The number of cycles required to attain 60% of the initial discharge capacity was deemed the charge/discharge cycle lifespan. For embodiment example 1 of the present invention, prior to charging, discharging was first performed to 0.5 to 1.5 V, after which charging was performed. In the comparative examples, discharging was either not performed prior to charging, or discharging was performed to a discharging end voltage either less than 0.5 V or greater than 1.5 V. The results are shown in TABLE 1.

Ex. 2030 [Yasunami], ¶66; POR at 50; Sur-Reply at 16

Yasunami Does Not Disclose A Battery Voltage >4.2V



189. The state of charge is proportional to the open circuit voltage: the higher the state of charge, the higher the open circuit voltage is for the battery.[177] Based on the figure below, when the state of charge is 80%, the open circuit voltage is just above 4V. Accordingly, a POSITA would understand that Yasunami's applied voltage equal to maximum 4.3V corresponds to a battery voltage equal to about 4V and, according to the published literature, in no circumstance greater than 4.2V.

Ex. 2007 [Yao Decl.], ¶189; POR at 51-55

Yasunami Does Not Disclose A Battery Voltage >4.2V

Q. Okay. If there's a measurable current going through the battery, then there ought to be a measurable difference between the open circuit voltage and the externally applied voltage. Correct?

A. Correct.

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Q. And measurable difference between the open circuit voltage and the externally applied voltage ought to be proportional to the difference between -- let me withdraw that question.

The measurable difference between the open circuit voltage and the externally applied voltage ought to be proportional to the current flowing through the battery. Correct?

A. Yeah. And I assume you don't mean directly or linearly. In some way, more current, higher voltage. Higher difference.

Ex. 2008 [Hruska Dep.] at 161:21-162:11; Sur-Reply at 16

Yasunami Does Not Teach Constant Voltage Charging



192. I disagree. There is no suggestion in Yasunami that the battery there should exceed the traditional limit of 4.2V of charge cutoff voltage, or that its charge cutoff voltage should (or could safely) be elevated. Instead, by only using constant current charging, a POSITA would understand that Yasunami was following the conventional wisdom and limited the charge cutoff voltage to 4.2V or lower.

Ex. 2007 [Yao Decl.], ¶192; POR at 55; Sur-Reply at 16-17

Apple Fails to Prove Yasunami's "End-of-Charge Voltage" Range Overlaps with the CCV Range



194. *First*, Mr. Hruska does not explain how the disclosed "end-of-charge voltage" (i.e., applied voltage) range in Yasunami will be translated to a charge cutoff voltage (i.e., battery voltage) range. There is thus no evidence that the two ranges overlap.

Ex. 2007 [Yao Decl.], ¶194; POR at 56; Sur-Reply at 17-18

The Claimed CCV Range is Critical

A presumption of obviousness is overcome if the patentee can show that "the prior art taught away from the claimed invention" or "there were new and unexpected results relative to the prior art."

Allergan, Inc. v. Sandoz Inc., 796 F.3d 1293, 1305 (Fed. Cir. 2015).



The Claimed CCV is Critical



196. Mr. Hruska claims that the '641 Patent fails to show any unexpected results because it does not present any data for charge cutoff voltage below 4.2V. But a POSITA would understand that below 4.2V, the battery would have lower capacity and longer cycle life. A POSITA would also understand that the conventional wisdom was that exceeding 4.2V would lead to decreasing cycle life. In contrast, the '641 Patent teaches the unexpected and surprising result that when the charge cutoff voltage was increased and the capacity ratio was adjusted to be within the disclosed range, the capacity of the secondary lithium-ion battery increased, and the battery still maintained excellent cycle life.[184] The '641 Patent includes numerous examples of those results. One was Example 2, where batteries were charged to 4.3V: the capacity increased from 1113 mAh to 1206 mAh, and the cycle life surprisingly also improved (maintaining 86.31% of capacity after 400 cycles, compared to 85.72% of capacity at 4.2V after 400 cycles).[185]

POR at 58; Sur-Reply at 17; Ex. 2007 [Yao Decl.], ¶196

The Claimed CCV is Critical

Example 1

Several lithium ion cells of quadrate type 653466 are prepared according to the above method, and they each have a ratio of positive electrode material to negative electrode material of 1:1.0, 1:1.05, 1:1.1, 1:1.15, 1:1.2, 1:1.25 and 1:1.3. After formation and test using an charge cut-off voltage of 4.20 V, these cells have an arithmetic mean capacity of 1113 mAh, a weight specific energy of 102 Wh/kg, an average operating voltage of 3.70 V, and maintain 85.72% of capacity after 400 recycles.

Example 2

Several lithium ion cells of quadrate type 653466 are prepared according to the above method, and they each have a ratio of positive electrode material to negative electrode material of 1:1.0, 1:1.05, 1:1.1, 1:1.15, 1:1.2, 1:1.25 and 1:1.3. After formation and test using an charge cut-off voltage of 4.30 V, these cells have an arithmetic mean capacity of 1206 mAh, a weight specific energy of 113 Wh/kg, an average operating voltage of 3.75 V, and maintain 86.31% of capacity after 400 recycles.

Example 3

Several lithium ion cells of quadrate type 653466 are prepared according to the above method, and they each have a ratio of positive electrode material to negative electrode material of 1:1.0, 1:1.05, 1:1.1, 1:1.15, 1:1.2,1:1.25 and 1:1.3. After formation and test using an charge cut-off voltage of 4.35 V, these cells have an arithmetic mean capacity of 1253 mAh, a weight specific energy of 119 Wh/kg, an average operating voltage of 3.8 V, and maintain 84.79% of capacity after 400 recycles.

POR at 58; Sur-Reply at 17; APPLE-1001 [the '641 Patent] at 10:26-61

Koyama Teaches Reducing Cathode Materials

[0006]

[Means for Solving the Problem]

The invention according to claim 1 is a secondary battery comprising a positive electrode, a negative electrode, and a nonaqueous electrolyte, wherein the capacity ratio (B/A) between the electrode capacity A of the positive electrode and the electrode capacity B of the negative electrode is $1.3 < (B/A) \leq 2.5$.

[0007]

If the capacity ratio (B/A) is less than 1.3, the improvement in charging characteristics is insufficient. Therefore, a value of 1.4 or higher is preferred. Meanwhile, if the capacity ratio (B/A) exceeds 2.5, the increase in the ratio of the negative electrode in a fixed volume battery container causes the absolute volume of the positive electrode to decrease in relative terms, resulting in a decrease in battery capacity and an increase in irreversible capacity, which in turn reduces the actual capacity that can be drawn upon.

POR at 19-20; Ex. 2007 [Koyama], ¶96

Yasunami Teaches Away from Reducing Cathode Materials

fact that the dendritic metal itself is highly active. To combat this, fired carbonaceous materials have recently been developed that are able to absorb and release lithium. These carbonaceous materials proffer numerous advantages, including relatively low risk of igniting, high charge/discharge capacity, etc. However, a drawback is that, because the material itself is conductive, overcharging or rapid charging can cause lithium metal to precipitate onto the carbonaceous material, again leading to dendritic metal precipitation. A variety of methods have been adopted to avoid this, including modifying the charger or reducing the amount of positive electrode active material so as to prevent overcharging. However, a problem with the latter method is that limiting the amount of active material, which in turn limiting the discharge capacity. Furthermore, due to the fact that carbonaceous material has a relatively low density, the latter method also winds up having a low discharge capacity per unit volume. Consequently, discharge capacity ends up being limited in two ways: limited amount of active material and low capacity per unit volume.

Ex. 2030 [Yasunami], ¶2; POR at 18; Ex. 2007 [Yao Decl.], ¶¶75-77

Combining Yasunami and Koyama Produces Redundant Benefits and Obvious Drawbacks



80. A POSITA would understand that lithium-containing transition metal oxide is fundamentally different from carbonaceous material as an anode active material. The key distinction relevant to Yasunami is their respective potential relative to lithium metal. Graphite, a common carbonaceous anode material, operates at a low electrode potential close to lithium metal (0.1-0.2V *vs.* Li/Li^+), which makes it attractive as the low potential allows the battery to maximize the voltage difference between the cathode and the anode. The greater voltage difference in turn results in a higher overall energy density for the battery.

POR at 18, 59-61; Ex. 2007 [Yao Decl.], ¶80

Combining Yasunami and Koyama Produces Redundant Benefits and Obvious Drawbacks



81. However, as Yasunami states, due to its low potential, it is easier to have lithium plating when graphite is used as the anode active material. In contrast, lithium transition metal oxides, such as $LiCoVO_4$, operate at a higher potential than graphite.[51] Given the higher potential, using lithium transition metal oxides reduces the risk of lithium plating on the anode during charging, which enhances safety. In other words, Yasunami proposes to use this category of purportedly new anode material to address the issue of lithium plating.

POR at 18, 59-61; Ex. 2007 [Yao Decl.], ¶81

Combining Yasunami and Koyama Produces Redundant Benefits and Obvious Drawbacks

(0044) The positive electrode active material and negative electrode active material used in the present invention obtained in the manner described above are compounds in which the valence of the transition metal is likely to change as lithium ions are absorbed and released during charging and discharging. Accordingly, the negative electrode active material of the present invention is fundamentally different in concept from metallic negative electrode active materials made of lithium metal and lithium alloy and the like, in which charging and discharging causes lithium to precipitate and dissolve. Furthermore, even in comparison with carbonaceous compounds, carbon in a compound clearly does not change valence, and its high conductivity facilitates the precipitation of lithium metal during charging. Consequently, the negative electrode active material of the present invention is a negative electrode active material that differs fundamentally in concept from lithium metals and carbonaceous materials.

Ex. 2030 [Yasunami], ¶44; POR at 18, 59-61

Combining Yasunami and Koyama Produces Redundant Benefits and Obvious Drawbacks



203. Given Yasunami's teaching, a POSITA would not have been motivated to modify Yasunami to adopt the capacity ratio as described by Koyama. As an initial matter, Koyama's proposed approach is exactly the approach that Yasunami considers inferior. Yasunami states that reducing the cathode active material is disfavored because it reduces discharge capacity. Koyama suggests having more anode capacity than cathode capacity in a battery.[195] A POSITA would not have combined Yasunami with an approach that Yasunami explicitly states as inferior.[196]

Ex. 2007 [Yao Decl.], ¶203; POR at 18, 59-61; Sur-Reply at 18-20

Combining Yasunami and Koyama Produces Redundant Benefits and Obvious Drawbacks



204. More importantly, a POSITA would understand that any benefit Koyama's approach would add to the battery in Yasunami is negligible. That is because by using lithium transition metal oxides as the anode active material, Yasunami purports to have already addressed the issue of lithium plating. However, Yasunami's approach also reduces energy density due to the high potential of Yasunami's anode active material. Accordingly, a POSITA would not combine Yasunami with Koyama, since doing so would reduce energy density even further, without any appreciable benefit.

Ex. 2007 [Yao Decl.], ¶204; POR at 18, 59-61; Sur-Reply at 18-20

Combining Yasunami and Koyama Produces Redundant Benefits and Obvious Drawbacks

(0032) The ratio of the positive electrode active material to the negative electrode active material used in the non-aqueous secondary battery of the present invention can be set arbitrarily according to the type of active materials to be combined.

Ex. 2030 [Yasunami], ¶32; POR at 19, 61; Sur-Reply at 20-21

Combining Yasunami and Koyama Produces Redundant Benefits and Obvious Drawbacks



205. *Second*, given Yasunami's disclosure, a POSITA would not have looked to a reference that discloses a capacity ratio of a secondary lithium-ion battery. As discussed above, Yasunami states that the ratio between the positive electrode active material to the negative electrode active material "can be set arbitrarily according to the type of active materials to be combined."[197] To the extent that the ratio disclosed in paragraph 19 of Yasunami refers to the ratio of the positive electrode active material to the negative electrode active material in the secondary lithium-ion battery, Yasunami states that any ratio is "preferred."[198] A POSITA reviewing Yasunami would understand that the ratio between the cathode and anode is not a design parameter that would have a significant impact on the performance of the battery. Given this teaching from Yasunami, a POSITA would not have been motivated to combine Yasunami with Koyama, a reference that teaches a design parameter that Yasunami does not focus on and whose approach would reduce the energy density of the battery in Yasunami.

Ex. 2007 [Yao Decl.], ¶205; POR at 61; Sur-Reply at 20-21

Outline

1. The ’641 Patent
2. Claim Construction: “charge cut-off voltage”
3. Claim 5 is not obvious over Yamaki and Sakamoto (Ground 1A - Claims 5-8 and 11-14; Ground 1B - Claims 9-10)
4. Claim 5 is not obvious over Yasunami and Koyama (Ground 2A – Claims 5-14; Ground 2B – Claims 9-10)
5. **Neither of Petitioner’s combinations renders obvious claims 11-14 (Ground 1A; Ground 2A)**

Claims 11-14 Properly Narrow Claim 5

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.

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.

APPLE-1001 [the '641 Patent], Cl. 11-14