UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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ZHUHAI COSMX BATTERY CO., LTD.,
Petitioner

v.

NINGDE AMPEREX TECHNOLOGY LIMITED,
Patent Owner

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Case IPR2025-00389
U.S. Patent No. 11,923,498

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**DECLARATION OF ULRICH VON SACKEN, PH.D. IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 11,923,498**

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# I. INTRODUCTION

1. I, Ulrich von Sacken, have been retained on behalf of ZHUHAI COSMX BATTERY CO., LTD ("Petitioner" or "CosMX") to provide an analysis of U.S. Patent No. 11,923,498 ("the '498 patent"). I understand that Petitioner is requesting that the Patent Trial and Appeal Board ("PTAB" or "Board") institute an *inter partes* review ("IPR") proceeding of the '498 patent.

2. I have been asked to provide my independent analysis of the '498 patent in light of the prior art publications cited below.

3. I am not, and never have been, an employee of Petitioner. I received no compensation for this declaration beyond my normal hourly compensation based on my time actually spent analyzing this patent, the prior art publications cited below, and the issues related thereto, and I will not receive any added compensation based on the outcome of any IPR or other proceeding involving these patents.

# II. MY PROFESSIONAL EXPERIENCE AND QUALIFICATIONS

4. A copy of my curriculum vitae ("CV") is submitted with this declaration as Exhibit 1004. As my CV indicates, I am an Expert Consultant residing in Sidney, British Columbia, Canada.

5. I have a B.Sc. (Hon) in Physics and an M.Sc. in Physics from the University of British Columbia. I also received a Ph.D. in Physics from the

University of Waterloo in 1985.

6. Since earning my PhD, I have had over 35 years of professional experience in the areas of design, manufacture, testing, and failure analysis of lithium-ion batteries.

7. Between 1987 and 2007, I was employed at E-One Moli Energy Canada and its predecessor companies. E-One Moli was a world leading manufacturer and developer of lithium-ion batteries. E-One Moli pioneered the development of lithium-ion technology and owned various patents and trade secrets related to cell production processes, alternative technologies, cell design, and the advancement of energy and power density of lithium-ion battery technology. During my time at E-One Moli, I rose to the position of General Manager of Research & Development and oversaw the commercialization of advanced lithium-ion cell designs, including the first manganese (Mn) oxide spinel power cells specifically designed for cordless power tools.

8. Between 2007 and 2013, I was VP of R&D at BAK Battery Canada. During my time at BAK, I was involved with many aspects of BAK's Li-ion cell manufacturing in China, particularly product quality, reliability and safety issues for cylindrical, prismatic, and polymer cells.

9. At both Moli and BAK, I led numerous battery failure investigations. The types of failures ranged from relatively benign issues such as self-discharge to

serious incidents such as fires involving multi-cell packs. I have been involved in more than 150 failure analysis investigations including dozens of a serious nature. I am familiar with various battery safety mechanisms, including the use of insulating tapes and adhesives integrated into the structure of a battery cell to prevent issues such as internal shorts and lithium plating. I have analyzed battery cell designs including such safety mechanisms to assess their impact on improving the reliability and safety of the battery cells.

10. Since 2013, I have been working as a consultant, providing analysis and advice regarding Lithium and Li-ion batteries to my clients, particularly on issues relating to failure analysis and cell design.

11. I am a named inventor on more than 13 patents and have authored more than 12 publications.

**Granted Patents:**

- J.S. Xue, A.M. Wilson, J.R. Dahn, Y. Liu, U. von Sacken, Qiming Zhong, Tao Zheng, "Pre-graphitic carbonaceous insertion compounds and use as anodes in rechargeable batteries," U.S. Patent No. 6,316,144 (granted Nov. 13, 2001).
- Tatsuji Numata, Junji Tabuchi, Yuichi Kumeuchi, Atsushi Ochi, Ulrich von Sacken, Zoon Kuimii, "Positive Electrode Active Material for Organic Electrolyte Secondary Battery," JP3363007 (granted Oct.

25, 2002).

- Yu Wang, Meiji Zhang, Ulrich von Sacken, Brian Way, "Additives for improving cycle life of non-aqueous rechargeable lithium batteries," U.S. Patent No. 6,045,948 (granted Apr. 4, 2000); EP0903798 (granted Oct. 17, 2001); JP11149943 (granted June 2, 1999); CA2215756 (granted Apr. 4, 2006).
- Huanyu Mao and Ulrich von Sacken, "Aromatic monomer gassing agents for protecting non-aqueous lithium batteries against overcharge," U.S. Patent No. 6,033,797 (granted Mar. 7, 2000); U.S. Patent No. 5,776,627 (granted July 7, 1998); JP3061759 (granted Apr. 28, 2000); EP0776058 (granted Aug. 29, 2001).
- Huanyu Mao, Ulrich von Sacken, Jan Reimers, "Additives for improving cycle life of non-aqueous rechargeable lithium batteries," U.S. Patent No. 5,891,592 (granted Apr. 6, 1999); JP10223258 (granted Aug. 21, 1998); EP0856901 (granted May 15, 2002).
- Qiming Zhong, Ulrich von Sacken, Jan Reimers, "Method of Reducing the Surface Area of Carbonaceous Powders," JP10059703 (granted Mar. 3, 1998); CA2176452 (granted Dec. 2, 2008).
- Qiming Zhong and Ulrich von Sacken, "Use of P2O5 in non-aqueous rechargeable lithium batteries," U.S. Patent No. 5,789,105 (granted

Aug. 4, 1998); CA2150877 (granted Apr. 16, 2002).

- Ulrich von Sacken, Wendy Chow, Allen Shkuratoff, "Battery with improved safety during mechanical abuse," U.S. Patent No. 5,747,188 (granted May 5, 1998).
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- Qiming Zhong and Ulrich von Sacken, "Low viscosity electrolyte comprising P2O5 for use in non-aqueous rechargeable lithium batteries," U.S. Patent No. 5,650,245 (granted July 22, 1997).
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## III. LEGAL PRINCIPLES

12. In forming my analysis and conclusions expressed in this declaration, I have applied the legal principles described in the following paragraphs, which were provided to me by counsel for Petitioner.

13. I have been informed that prior art is that which was known or used by others in the U.S., or was patented or published anywhere, before the Applicant's invention. I further have been informed that prior art includes that which was patented or published anywhere, or was in public use, on sale, or offered for sale in this country, more than one year prior to the filing date of the patent application (critical date). I have also been informed that prior art includes that which was described in a U.S. patent granted on an application for a patent (or in a published application for a U.S. patent) that was filed by another in the U.S. before the date of invention for such a claim.

**A. Obviousness**

14. I have been informed that a patent claim is invalid as "obvious" in light of one or more prior art references if it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention ("POSA"), taking into account (1) the scope and content of the prior art, (2) the differences between the prior art and the claims, (3) the level of ordinary skill in the art, and (4) any so called "secondary considerations" of non-obviousness, which include: (i) "long felt need" for the claimed invention, (ii) commercial success attributable to the claimed invention, (iii) unexpected results of the claimed invention, and (iv) "copying" of the claimed invention by others.

15. I understand that a patent cannot be properly granted for subject matter that would have been obvious to a POSA at the time of the alleged invention, and that a patent claim directed to such obvious subject matter is invalid under 35 U.S.C. § 103. It is also my understanding that in assessing the obviousness of claimed subject matter one should evaluate obviousness over the prior art from the perspective of a POSA at the time the invention was made (and not from the perspective of either a layman or a genius in that art).

16. I have been informed that a claim can be obvious in light of a single prior art reference or multiple prior art references.

17. A patent can be obvious in light of a single prior-art reference if it

would have been obvious to modify that reference to arrive at the patented invention. To be obvious in light of a single prior art reference or multiple prior art references, there must be a reason that would have prompted a POSA to modify the single prior art reference, or combine two or more references, in a manner that provides the elements of the claimed invention. This reason may come from a motivation to combine, or may come from the reference(s) themselves, the knowledge and "common sense" of a POSA, or from the nature of the problem to be solved, and this reason may be explicit or implicit from the prior art as a whole. I have been informed that, under the law, the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results. In addition, I have been told the inferences and creative steps a POSA would employ are also relevant to the determination of obviousness. I also understand it is improper to rely on hindsight in making the obviousness determination.

18. In determining whether a prior art reference would have been combined with another prior art reference or other information known to a POSA, I have been told that the following principles may be considered:

- A combination of familiar elements according to known methods is likely to be obvious if it yields predictable results;
- The simple substitution of one known element for another is likely to

be obvious if it yields predictable results;

- The use of a known technique to improve similar devices, products, or methods in the same way is likely to be obvious if it yields predictable results;
- The application of a known technique to a prior art reference that is ready for improvement is likely obvious if it yields predictable results;
- Any need or problem known in the field and addressed by the reference can provide a reason for combining the elements in the manner claimed;
- A skilled artisan often will be able to fit the teachings of multiple references together like a puzzle; and
- The proper analysis of obviousness requires a determination of whether a POSA would have a "reasonable expectation of success"—not "absolute predictability" of success—in achieving the claimed invention by combining prior art references.

19. I understand that a dependent claim contains all of the limitations of the independent claim from which it depends. Thus, to establish unpatentability, every limitation set forth in a dependent claim as well as the independent claim from which it depends must be found in the prior art or be obvious from the prior art.

### B. Claim Construction

20. I understand that, for purposes of my analysis in this *inter partes* review proceeding, the terms appearing in the patent claims should be interpreted according to their "ordinary and customary meaning." In determining the ordinary and customary meaning, the words of a claim are first given their plain meaning that those words would have had to a POSA. I understand that the structure of the claims, the specification, and the file history also may be used to construe a claim insofar as the plain meaning of the claims cannot be understood. Moreover, treatises and dictionaries may be used, albeit under limited circumstances, to determine the meaning attributed by a person of ordinary skill in the art to a claim term at the time of filing. I have followed this approach in my analysis, and for all of the claim terms considered in this declaration, I have applied the plain and ordinary meaning of those terms.

21. I also understand that the words of the claims should be interpreted as they would have been interpreted by a POSA at the time the alleged invention was made (not today).

## IV. MATERIALS CONSIDERED AND BASIS OF OPINIONS

22. My opinions are based on more than 40 years of working with battery systems, components and reliability. My opinions are also based on investigation and study of the relevant materials, including the patent at issue and its file history,

and the prior art. In the course of forming my opinions I have reviewed the following exhibits of record and any other materials referenced herein:

| Exhibit # | Description |
|---|---|
| **1001** | U.S. Patent No. 11,923,498 B2 to Tao ("the '498 patent") |
| **1002** | Prosecution File History of U.S. Patent No. 11,923,498 B2 ("'498 File History") |
| **1005** | U.S. Patent Pub. No. 2011/0111276 to Sato *et al.* |
| **1006** | Japanese Patent Pub. No. 2000-67907 to Takemura *et al.* |
| **1007** | U.S. Patent Pub. No. 2011/0104539 to Oh *et al.* |
| **1008** | Japanese Patent Pub. No. 2010-55906 to Kobayashi *et al.* |
| **1009** | Japanese Patent Pub. No. 10-326629 to Maejima *et al*. |
| **1010** | Japanese Patent Pub. No. 11-26008 to Yamauchi *et al*. |
| **1011** | Japanese Patent Pub. No. 2000-285902 to Mizutani *et al.* |
| **1012** | Japanese Patent Pub. No. 2003-068271 to Nakamura *et al*. |
| **1013** | Japanese Patent Pub. No. 2007-165224 to Yoneda *et al*. |
| **1014** | U.S. Patent Pub. No. 2006-0051662 to Kwak *et al.* |
| **1015** | U.S. Patent Pub. No. 2007-0172736 to Fujikawa *et al*. |
| **1016** | Japanese Patent Pub. No. 2008-171593 to Aoki *et al*. |
| **1017** | U.S. Patent Pub. No. 2010-0035144 to Oh *et al*. |
| **1018** | Korean Patent Pub. No. 2013-0085202 to Lee *et al.* |
| **1019** | Agubra *et al.*, "Lithium Ion Battery Anode Aging Mechanisms" |
| **1020** | Smart *et al.*, "Effects of Electrolyte Composition on Lithium Plating in Lithium-Ion Cells" |
| **1021** | Ratnakumar *et al.*, "Lithium Plating Behavior in Lithium-ion Cells" |

| Exhibit # | Description |
|---|---|
| **1022** | Eberman et al., "Material and Design Options for Avoiding Lithium-Plating during Charging" |
| **1023** | Wen *et al*., "A Review on Lithium-Ion Battery Safety Issues: Existing Problems and Possible Solutions." |
| **1024** | Complaint and Exhibit N filed in *Ningde Amperex Technology Ltd. V. Zhuhai CosMX Battery Co., Ltd.*, Case No. 2:24-ccv-728 (E.D. Tex.) |

23. I confirm that to the best of my knowledge the accompanying exhibits are true and accurate copies of what they purport to be, and that an expert in the field would reasonably rely on them to formulate opinions such as those set forth in this Declaration.

24. I may rely upon these materials and/or additional materials to rebut arguments raised by the patent owner. Further, I may also consider additional documents and information in forming any necessary opinions – including documents that may not yet have been provided to me.

25. My analysis of the materials relevant to this proceeding is ongoing and I will continue to review any new material as it is provided. This report presents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials already provided.

26. In my opinion, claims 1-22 of the '498 patent are unpatentable as

obvious in view of the prior art. The following table summarizes the grounds that are detailed below that I believe show unpatentability.

| Ground | Prior Art Combination | Claims |
|---|---|---|
| 1 | Sato, Takemura | 1-3, 6, 8, 17, 19 |
| 2 | Sato, Takemura, Nakamura | 4, 5, 7, 18 |
| 3 | Sato, Takemura, Oh-539, Oh-144 | 20, 22 |
| 4 | Sato, Takemura, Kobayashi | 9-11, 14, 16 |
| 5 | Sato, Takemura, Kobayashi, Nakamura | 12, 13, 15 |
| 6 | Sato, Takemura, Kobayashi, Oh-539, Oh-144 | 21 |
| 7 | Takemura, Oh-539, Kobayashi | 1-3, 9-11, 17 |
| 8 | Takemura, Oh-539, Kobayashi, Oh-144 | 20-22 |

## V. DESCRIPTION OF THE RELEVANT FIELD AND A PERSON OF ORDINARY SKILL IN THE RELEVANT FIELD (ART)

27. In my opinion, "a person of ordinary skill in the relevant field" is a hypothetical person to whom an expert in the relevant field could assign a routine task with reasonable confidence that the task would be successfully carried out. I have been informed that evidence of the level of ordinary skill in the art can be determined based on information about the field including: the types of problems encountered, known solutions, the speed of innovation, sophistication, and the educational level of active workers. I have considered these types of information

along with my own educational and industry background in the field to reach my conclusion.

28. I have been advised that a person of ordinary skill in the "relevant field" (art), (a POSA), must be able to make and use the claimed invention based on the information disclosed in the specification of the patent. Accordingly, where information is required to make and use the claimed invention but has not been expressly disclosed in the specification, the patentee effectively acknowledges that such information should be considered to be within the knowledge of the hypothetical POSA. Whether I use the acronym POSA or not, all of my opinions throughout this declaration are based on the understanding of a POSA at the time of the effective filing date of the '498 patent.

29. Based on my analysis of the '498 patent, it is my opinion that a POSA at the date attributed to the invention would have had a Bachelor's Degree in Physics or an Engineering field relevant to battery technology (e.g., an Electrical Engineering degree or Mechanical Engineering degree) and at least two years of industry experience in lithium-ion battery manufacturing and/or design. Based on my educational background and industry experience, I qualify as at least a POSA at the time of the alleged invention of the patents. And, based on my experience, I have an understanding of the capabilities of a person of ordinary skill in the relevant field. I have supervised, directed, and instructed many such persons over

the course of my career.

## VI. THE DATE OF THE PATENT

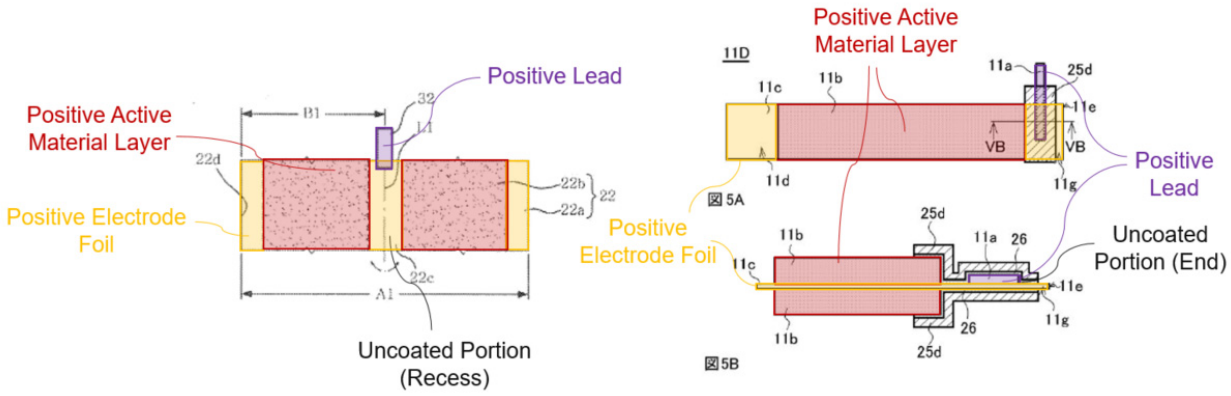
30. The ’498 patent was filed on May 17, 2022 and claims priority, through multiple intervening applications, to Chinese Application No. 201420030319.4, filed on January 17, 2014. For purposes of my analysis here, I have been advised by counsel to assume a date of January 17, 2014 as the date governing my obviousness analysis.

## VII. BACKGROUND OF CONVENTIONAL LITHIUM-ION BATTERY TECHNOLOGY

31. Conventional lithium-ion batteries have a cathode and an anode, a separator disposed between the cathode and the anode, and an electrolyte filling the pores of the cathode, anode, and separator and the spaces between them. EX1010, ¶¶¶¶[0018], [0021], [0022]; EX1013, ¶¶[0008], [0012], [0062]; EX1017, ¶[0025]; EX1007, ¶¶ [0004], [0039]; EX1008, ¶¶[0004], [0028].

32. The cathode, also called a positive electrode, typically includes a positive electrode foil (also called a positive electrode current collector) coated with a positive electrode active material, such as lithium composite oxide. EX1007, ¶[0084]; EX1008, ¶[0016]. A positive electrode lead is attached to the positive electrode foil at a portion of the positive electrode that is not coated with the positive electrode active material (also commonly called an “exposed” portion). EX1007, ¶¶[0045]-[0046]; EX1008, ¶[0034]. The position where the positive

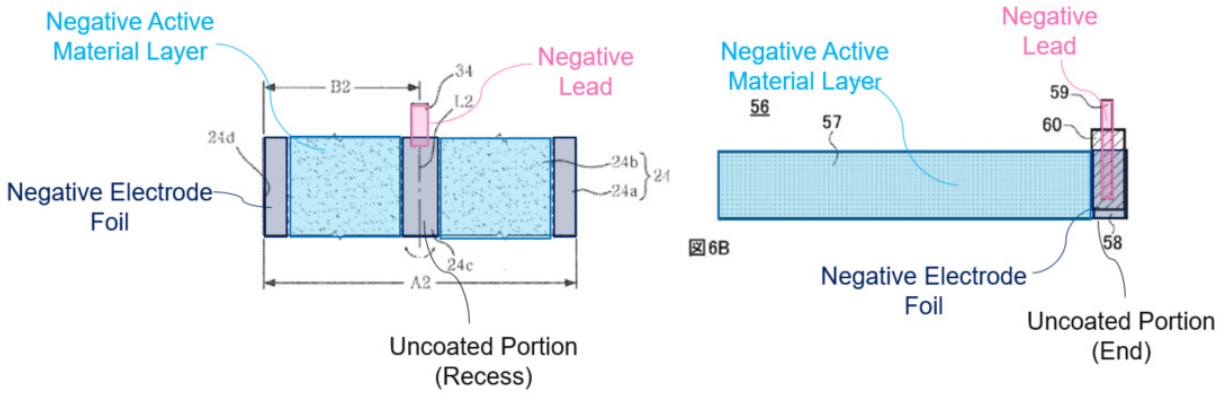
electrode lead is attached can be located at an uncoated end of the positive electrode or at an uncoated recess located along the length of the positive electrode. EX1007, ¶¶[0045]-[0046]; EX1008, ¶¶[0034], [0041], [0043].The following annotated versions of Figures 2 and 5 from Exhibits 1007 and 1008, respectively, illustrate some conventional positive electrode constructions.




EX1007, FIG. 2 (annotated); EX1008, FIG. 5 (annotated).

33. Similarly, the anode, also called a negative electrode, typically includes a negative electrode foil (also called a negative electrode current collector) coated with a negative electrode active material such as graphite. EX1007, ¶[0088]; EX1008, ¶[0017]. A negative electrode lead is attached to the negative electrode foil at a portion of the negative electrode that is not coated with the negative electrode active material. EX1007, ¶¶ [0058]-[0059]; EX1008, ¶[0007]. The position where the negative electrode lead is attached can be located at an uncoated end of the negative electrode or at an uncoated recess located along the length of the negative electrode. EX1007, ¶¶ [0058]-[0059]; EX1008,

¶[0007].The following annotated versions of Figures 3 and 6B from Exhibits 1007 and 1008, respectively, illustrate some conventional negative electrode constructions.




EX1007, FIG. 3 (annotated); EX1008, FIG. 6B (annotated).

34. During charging, lithium ions are removed (deintercalated) from the cathode (positive) active material and migrate via the electrolyte across the porous separator membrane to the negative electrode where they are reabsorbed (intercalated) into the anode (negative) active material.. EX1023, 199. During discharging the process is reversed and lithium ions move in the opposite direction. EX1023, 199. For these processes to proceed smoothly, it is necessary to provide sufficient anode capacity to absorb all the lithium ions released from the cathode. The ratio of anode capacity to cathode capacity is a critical parameter and "[l]i-ion cells are generally designed with excess anode capacity." EX1020, 379.

35. It has long been known that lithium-ion batteries have a risk of overheating or failing if the internal components are not property protected from

adverse chemical and/or mechanical issues, particularly internal shorts between anode and cathode, including those caused by unintended lithium plating.[1] . *See, e.g.*, EX1009, ¶[0002], EX1016, ¶[0010], EX1019, 1318; EX1021, 242; EX1022, 47; EX1023, 201. For that reason, internal battery protective layers or tapes are employed to ensure components of battery cells, such as electrode leads and electrode active materials, function as intended, even under extreme circumstances. *See generally* EX1006; EX1008-1018.

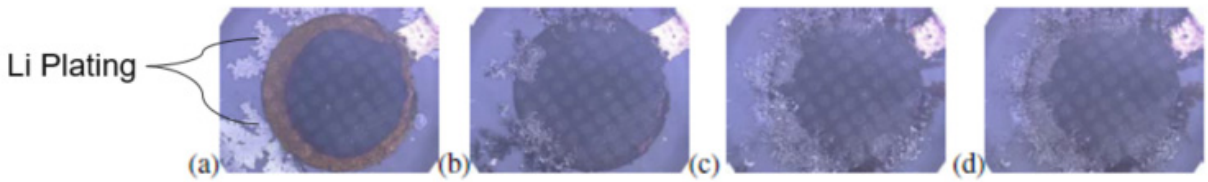
36. If the local anode capacity is insufficient to absorb the lithium ions released by the cathode during the charging then they will electroplate as lithium metal201. EX1019, 1317; EX1020, 379; EX1021,242; EX1023, 201. The plated lithium metal tends to grow toward the cathode as a branching "dendritic" deposit. EX1019, 1318; EX1020, 379; EX1023, 201. The formation of dendritic lithium "is one of the most common and important factors leading to internal short circuits of [a] lithium-ion battery." EX1023, 201. Significant depositing of dendritic lithium on the negative electrode can puncture the separator, thereby connecting the positive and negative electrodes and short-circuiting of battery. EX1023, 201.

37. It was known that any exposed metal on the negative electrode that is

[1] In the art, "lithium plating" can also be referred to as "lithium deposition" or "lithium precipitation."

located opposite to positive electrode active material is susceptible to lithium plating. EX1016, ¶[0008]. For example, Eberman *et al.* ("Material and Design Options for Avoiding Lithium-Plating during Charging") demonstrated significant lithium plating at exposed metal located around the edge of a negative electrode that was intentionally underlapped with the positive electrode active material on a positive electrode. EX1022, 51. The internal underlap created a situation where the positive electrode edge extended beyond that of the negative electrode. EX1022, Abstract. Due to this intentional underlap, exposed metal at the edge of the negative electrode was located opposite positive electrode active material in the experimental cell. EX1022, 51.

38. Figure 6a from Exhibit 1022 (reproduced and annotated below) shows "gross lithium plating occurred on the edge" of the exposed metal on the negative electrode cell. EX1022, 51. The lithium plating is shown by the presence of the fractal-like lighter colored regions.

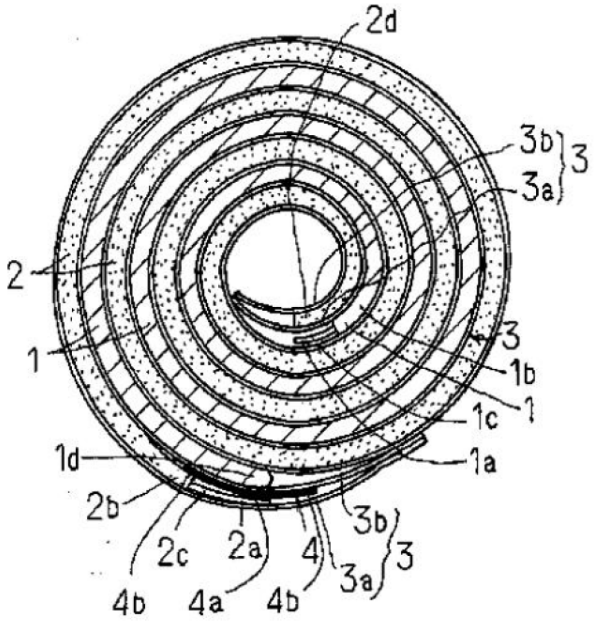



EX1022, FIG. 6 (annotated).

39. It was also well known before January 17, 2014, to position additional protective layers and tapes at strategic locations within battery cells to prevent

various potential reliability and safety issues, including lithium plating issues. *See generally* EX1006; EX1008-1018. Exhibits 1006 and 1008-1018 exemplify the use of additional internal insulating materials, such as insulating tapes and adhesives, for improving battery safety and performance that existed as early as 1997. These insulating materials were selectively applied to specific components of the lithium-ion batteries to solve safety and performance problems such as short-circuiting, lithium (Li) plating, and undesirable thermal expansion.

40. In 1997, Maejima *et al*. (JP 10-326629; EX1009) were working on developing a "lithium ion transfer preventing insulator" (insulator 4) designed to be positioned "anywhere between the negative electrode side lead wire connection and the positive electrode plate" within a lithium-ion battery. EX1009, ¶[0008]. As shown in Figure 1 (reproduced below), Maejima's lithium-ion battery included: (i) a positive electrode plate 1 with a positive electrode active material layer 1b and a positive electrode side lead 1c, (ii) a negative electrode plate 2 with a negative electrode active material layer 2b and a negative electrode side lead 2c, and (iii) a separator 3. EX1009, ¶¶ [0011]-[0012].

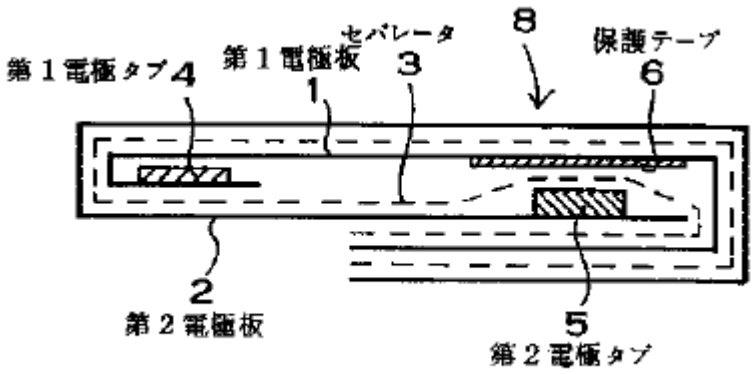



EX1009, FIG. 1.

41. Maejima's insulator 4 was a polymer sheet-like material capable of being attached to various components of the lithium-ion battery using bonding means such as an adhesive. EX1009, ¶¶[0010], [0013]. Maejima contemplated attaching the insulator 4 at various places to avoid lithium plating, including: (i) "between the portion of the positive electrode plate corresponding to the negative electrode side lead wire connection and the separator" or (ii) "between the negative electrode side lead wire connection and the separator" EX1009, ¶[0008]. For example, as shown above in Figure 1, Maejima's insulator 4 can be selectively placed between the positive electrode plate 1 and the negative electrode side lead 2c on the negative electrode plate 2 to prevent lithium plating at this location. EX1009, ¶[0007], [0008], [0013].

42. Comparative tests between a battery with Maejima's insulator 4 and one without the insulator 4 showed reduced lithium plating due to the presence of the insulator 4. EX1009, ¶¶ [0014]-[0016].

43. In parallel with Maejima, Yamauchi *et al*. (JP 11-26008; EX1010) were implementing insulating materials to avoid undesired electrical contact between electrodes in lithium-ion batteries. EX1010, Abstract, ¶[0007]. As shown in Figure 4 (reproduced below), Yamauchi's battery included: (i) a first (positive) electrode plate 1 with a first (positive) electrode tab 4, (ii) a second (negative) electrode plate 2 with a second (negative) electrode tab 5, and (iii) a separator 3. EX1010, ¶¶[0018], [0021], [0022].



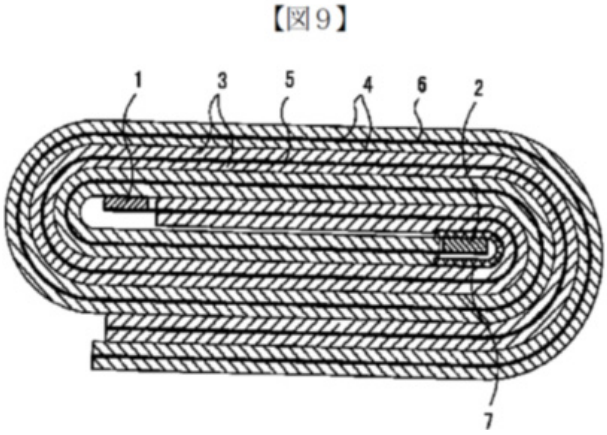

EX1010, FIG. 4.

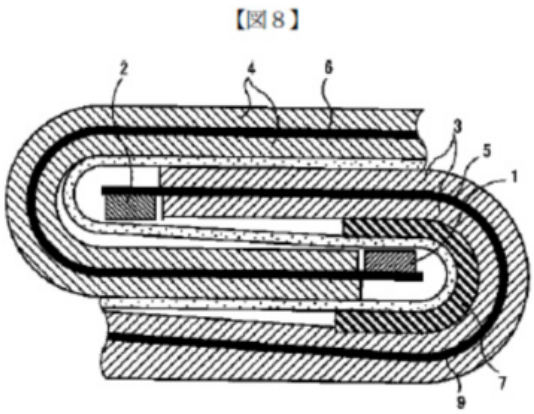
44. Yamauchi selectively placed protective tape 6 located between the second electrode tab 5 and the positive electrode 1 to prevent electrical contact between the negative electrode tab 5 and the positive electrode 1. EX1010,

¶¶[0005], [0007], [0019]. Yamauchi viewed the protective tape 6 as a key battery element to prevent short circuits caused by undesired electrical contact between the negative electrode tab 5 and the positive electrode 1 within the battery. EX1010, ¶¶[0029], [0031].

45. In 1998, Takemura *et al.* (JP 2000-67907; EX1006) were evaluating conventional lithium-ion batteries that used insulating tape to prevent lithium plating within the batteries. EX1006, ¶[0008]. To avoid lithium plating, these conventional batteries placed an insulating tape 7 on the positive electrode active material layer 3 adjacent to a negative electrode current collecting lead 2 and bare, exposed portions of the negative current collector 6. EX1006, ¶¶ [0003], [0008], FIGs. 8, 9. Takemura explained that the presence of the insulating tape 7 at this location prevented short-circuiting caused by lithium plating on exposed metal of the negative current collector 6. EX1006, ¶[0008]. Takemura's Figures 9 and 8[2] (reproduced below) show the positioning of the insulating tape 7 within the lithium-ion battery.

[2] Takemura mislabels the positive lead 1 and the negative lead 2 in Figure 8. The lead labeled "1" should be labeled "2" and the lead labeled "2" should be labeled "1."



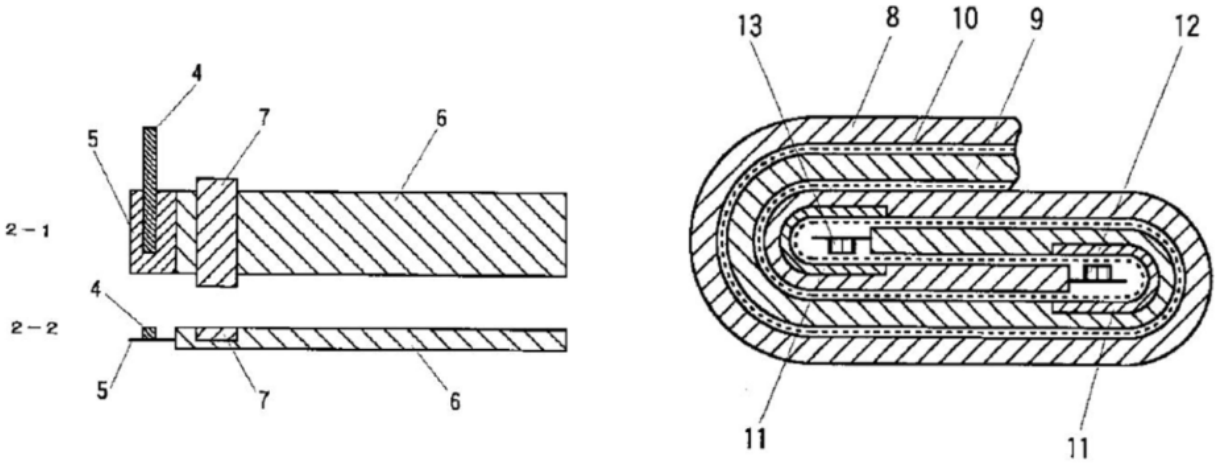




EX1006, FIGs. 9, 8.

46. In 1999, Mizutani *et al.* (JP 2000-67907; EX1011) developed a lithium-ion battery with insulating tapes positioned to avoid metal-to-metal shorts at the location of the positive and negative leads within the battery. In particular, Mizutani developed a lithium-ion battery with insulating tapes 7/11 selectively placed around both the positive electrode lead 12 and the negative electrode lead 13 within the battery. EX1011, ¶¶[0014], [0033]-[0034]. Mizutani explained that the insulating tape 7/11 was applied to avoid metal-on-metal shorts that can cause battery overheating and reduced safety. EX1011, ¶[0009].

47. The insulating tape 7/11 in Mizutani was "placed on one of the electrode plates, and a current collector end face or lead terminal that *does not retain active material* is present on the side of the other electrode plate opposite the one electrode plate." EX1011, ¶[0014 (emphasis added). In other words, insulating tape 7/11 in Mizutani was placed on the positive or negative active material

opposite "an exposed [metal] portion of the current collector where the active material is not retained." EX1011, ¶[0033]. Figures 2 and 3 of Mizutani (reproduced below) show how Mizutani placed the insulating tape 7/11 on electrode active materials 6 to cover exposed metal surrounding the positive electrode lead 12 and the negative electrode lead 13 within the lithium-ion battery's wound structure. EX1011, ¶¶[0033], [0034].

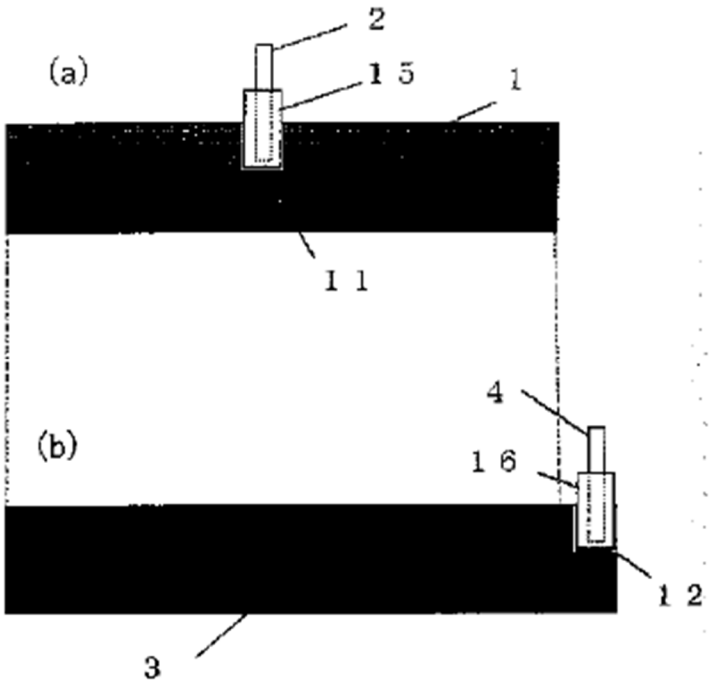



EX1011, FIGs. 2, 3.

48. Mizutani's data showed that selectively placing the insulating tape 7/11 around exposed metal on the positive and negative electrodes was successful in improving short-circuit resistance and safety. EX1011, ¶[0044].

49. In 2001, Nakamura *et al*. (JP 2003-068271; EX1012) were placing insulating tapes on both the negative and positive leads within a lithium-ion battery. As shown in Nakamura's Figure 1 (reproduced below), Nakamura's battery included: (i) a positive electrode plate 1 with a positive electrode lead 2

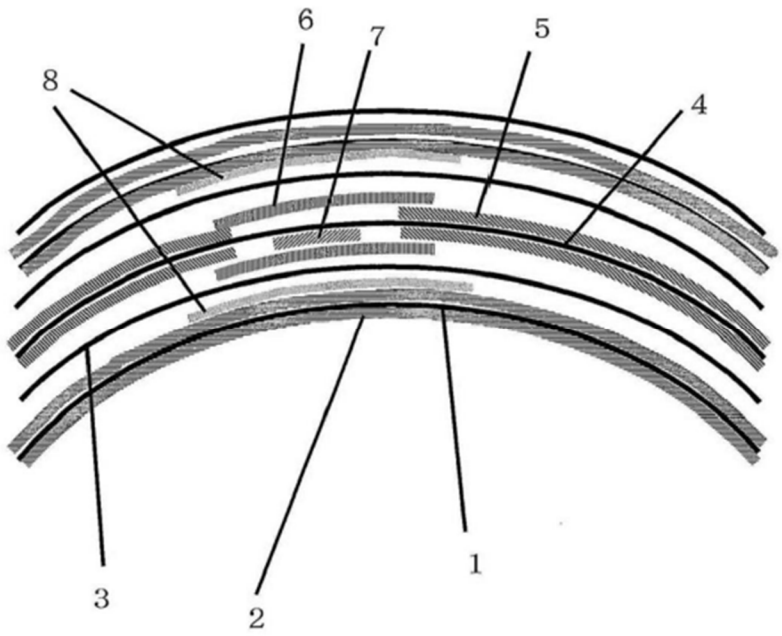
welded to a positive electrode active material-free portion 11, and (ii) a negative electrode plate 3 with a negative electrode lead 4 welded to a negative electrode active material-free portion 12. EX1012, ¶¶ [0024]-[0027]. Nakamura placed insulating tapes 15 and 16 such that the tapes covered the positive lead 2 and the negative lead 4, respectively, to prevent an internal short circuit. EX1012, ¶¶ [0052]-[0053].




EX1012, FIG. 1.

50. A few years later, in 2005, Yoneda *et al*. (JP 2007-165224; EX1013) were developing a lithium-ion battery with insulating tapes and protective films selectively positioned around the battery's positive lead. As shown for example in Figure 4 (reproduced below), Yoneda's battery included: (i) a positive electrode

current collector 4 with positive electrode active material 5 and a positive electrode lead 7 positioned within a recess (uncoated portion) in the positive electrode active material 5, (ii) a negative electrode current collector 1 with negative electrode active material 2, and (iii) a separator 3. EX1013, ¶¶[0008], [0012], [0062].




EX1013, FIG. 4.

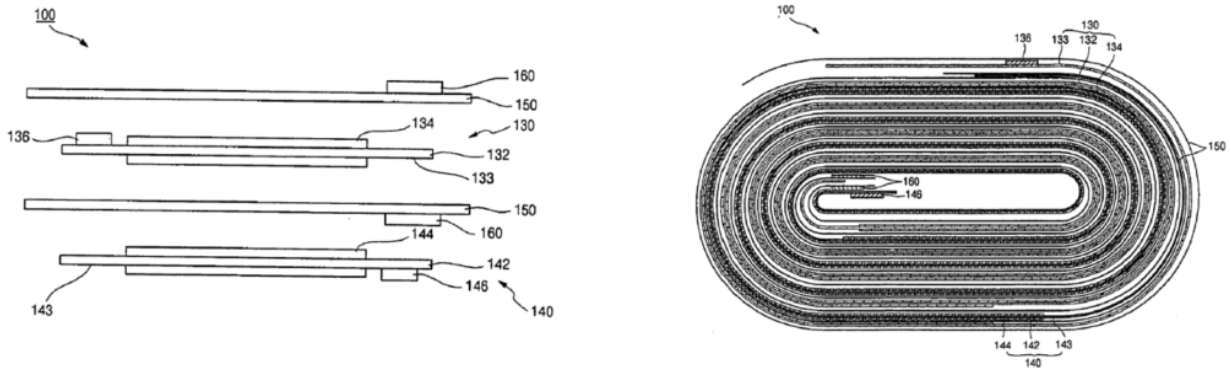
51. Yoneda's battery also included insulating tapes 6 and protective films 8. EX1013, ¶¶[0008], [0012], [0062]. The insulating tapes 6 were applied to the positive electrode current collector 4 to cover the uncoated and exposed metal surrounding the positive lead 7. EX1013, ¶¶[0008], [0012], [0062]. The protective films 8 were applied to the portion of the negative electrode active material 2 portion facing the uncoated portions on the positive electrode current collector 4. EX1013, ¶¶[0008]-[0009], [0012], [0014], and FIG. 4.

52. Yoneda positioned the tapes 6 and films 8 around the positive electrode lead 7 to suppress heat generation during an internal short circuit, and thereby improve the battery's safety performance. EX1013, ¶¶ [0007], [0011].

53. Kwak *et al.* (US 2006-0051662; EX1014) were also investigating selective application insulating tape within lithium-ion batteries in 2005. Kwak described positioning an adhesive insulator tape 160 at various places on a separator 150 within the battery's coiled structure. EX1014, ¶¶[0036], [0040]-[0048], FIGs. 3-5. Kwak explained that selectively positioning the insulator tape 160 helps hold the separator 150 in place and helps prevent the separator 150 from contracting heat is generated. EX1014, ¶¶[0041], [0042], [0048], [0049], [0054], [0057], and [0060]. By stabilizing the separator 150, Kwak was able to avoid short circuits that may occur between the positive electrode plate and the negative electrode plate due to separator contraction within the lithium-ion battery. EX1014, ¶¶[0015], [0017], [0032], [0049].

54. Kwak's Figures 4 and 5 (reproduced below) show the insulation tape 160 coupled to the separator 150 "in a position facing the first electrode plate uncoated portion [133] corresponding to the position of the first electrode tab [132]." EX1014, ¶ [0041]. Kwak's insulating tape 160 in Figures 4 and 5 was "sufficiently wide to be attached to the separator 150 in a position corresponding to the second electrode uncoated portion 133 of the second electrode plate 130" such

that it held "the separator 150 in place even when it is subjected to heat which prevents it from contracting." EX1014, ¶ [0042].



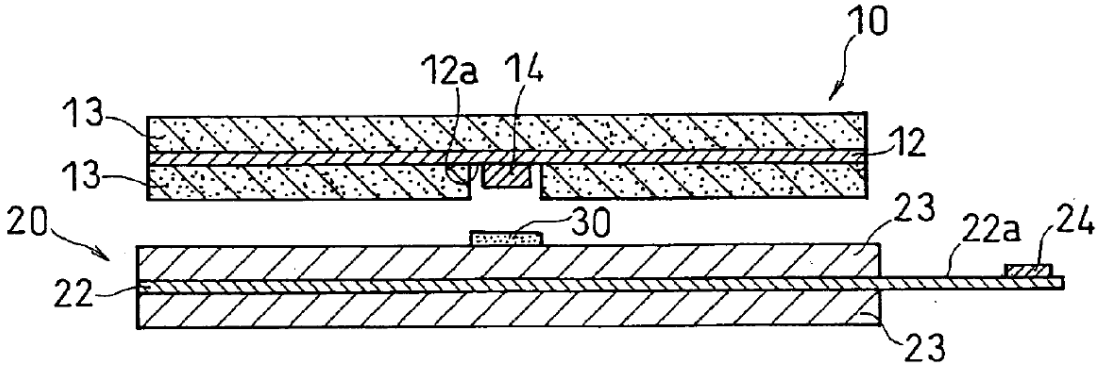

EX1014, FIGs. 4, 5.

55. Kwak also explained that the position of insulating tape 160 in Figures 4 and 5 "prevents the heat that is generated from the first electrode tab 146 portion from being directly transferred to the separator 150." EX1014, ¶[0041]. Kwak's Figures 6 through 8 show additional locations for insulating tapes 160 positioned to prevent undesired contraction of the separator 150. EX1014, ¶¶[0044], [0052], [0059].

56. Shortly after Kwak, in 2006, Fujikawa *et al*. (US 2007-0172736; EX1015) were developing lithium-ion batteries with heat resistant resin layers selectively applied either directly to a lead or to an active material layer opposite a lead within the battery's coil. In particular, Fujikawa was developing heat resistant resin layers to prevent internal short circuits at locations where the leads were coupled to a center portion of the electrodes. EX1015, ¶¶6, 12. Fujikawa was

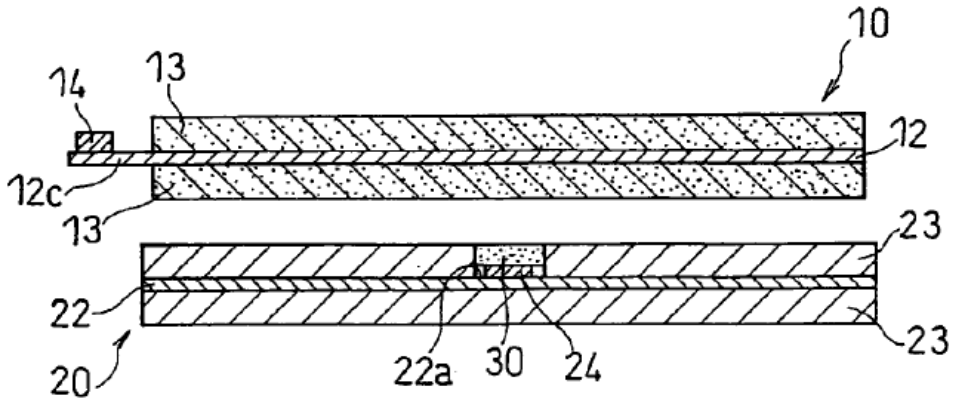
working on solutions for protecting "center exposed portions" where the leads were attached on the electrodes because positioning the leads at or near the center of the length of the electrodes reduced the "electrical resistance of the electrode" to "offer high output power." EX1015, ¶24.

57. Figure 1 of Fujikawa (reproduced below) shows a heat resistant resin layer 30 "formed on the negative electrode active material layer 23 such that it faced the center exposed portion 12a of the positive electrode 10." EX1015, ¶67.




EX1015, FIG. 1

58. As another example from Fujikawa, Figure 4 (reproduced below) shows a heat resistant resin layer 30 "directly formed on the negative electrode 20 such that the first heat resistant layer covered the center exposed portion 22a having the negative electrode current collecting lead 24 connected thereto." EX1015, ¶90.




EX1015, FIG. 4.

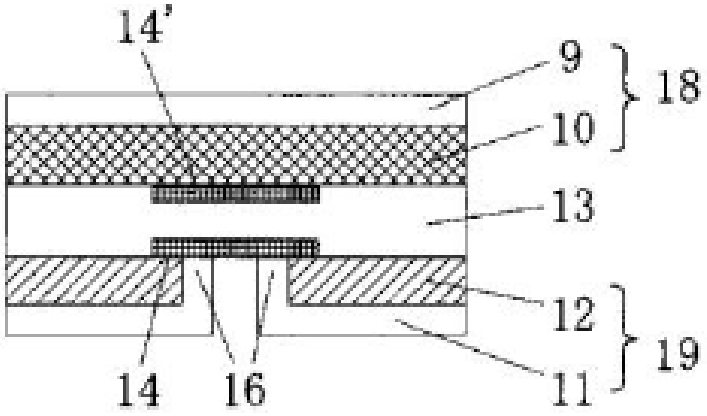
59. Fujikawa also explained that in an alternative embodiment to that shown in Figure 4, the battery was "produced in the same manner as [shown in FIG. 4] except that the first heat resistant layer 30 was formed on the positive electrode 10 such that the first heat resistant layer faced the center exposed portion 22a having the negative electrode current collecting lead 24 connected thereto." EX1015, ¶92. In other words, in the alternative embodiment, Fujikawa placed the heat resistant layer 30 on the positive electrode active material layer 13 opposite to the center exposed portion 22a housing the negative electrode current collecting lead 24.

60. Fujikawa concluded with data and analysis that showed "it is difficult to ensure safety in external short circuit conditions without the first heat resistant layer [30]." EX1015, ¶117. According to Fujikawa, positioning heat resistant resin layers 30 directly on a centrally located lead ***or*** on an active material layer opposite a lead within the battery's coil "is of great value as a highly safe lithium secondary

battery capable of offering high output power." EX1015, ¶118.

61. Also during 2007, Aoki *et al*. (JP 2008-171593; EX1016) evaluated battery designs with an insulating material that covered "the metal portion exposed on the surface of the negative electrode layer." EX1016, ¶10. According to Aoki, positioning the insulating material to cover exposed metal on the negative electrode was necessary because "lithium precipitation occurs on the exposed metal portion of the surface of the negative electrode layer." EX1016, ¶10.

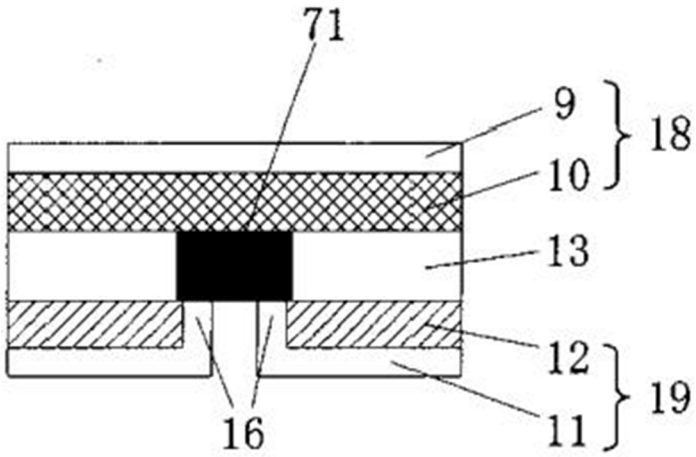
62. Figure 6 of Aoki (reproduced below) shows a conventional method of using insulating seal tape 14' specifically to prevent lithium plating. EX1016, ¶12. The insulating seal tape 14' covered "the positive electrode layer that is opposite to the negative electrode coated portion via a separator." EX1016, ¶12.




EX1016, FIG. 6.

63. As an alternative to sealing tapes, Aoki evaluated battery designs with an insulating composition impregnated within a separator to prevent lithium

plating. Aoki's Figure 7 (reproduced below) show this battery design with the insulating composition 71.



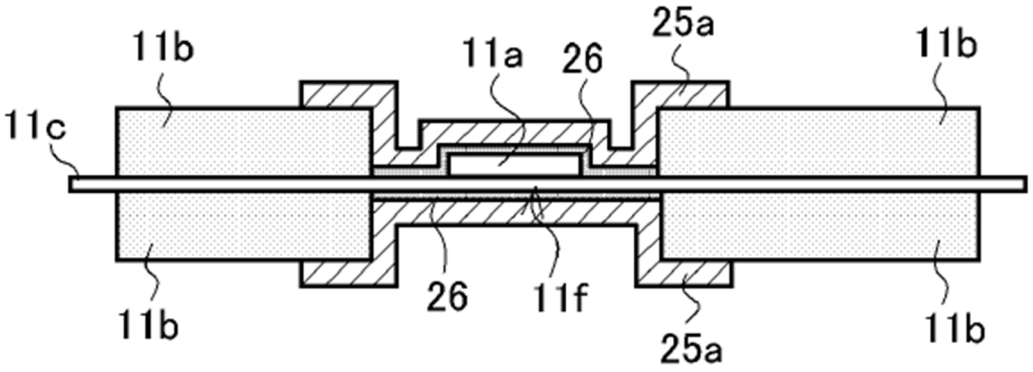

EX1016, FIG. 7.

64. Aoki's battery included: (i) a positive electrode 18 with a positive electrode current collector 9 and positive electrode active layer 10, (ii) a negative electrode 19 with a negative electrode active layer 12 and negative electrode current collector 11 having an exposed metal portion 16, and (iii) a separator 13. EX1016, ¶¶24-25. Aoki's insulating composition 71 was impregnated in the separator 13 and "completely" covered the exposed metal portion 16 on the negative electrode 19. EX1016, ¶¶24-25.

65. According to Aoki, "lithium precipitation can be effectively suppressed by covering and insulating the metal portions exposed on the surface of the negative electrode layer, together with the corresponding portion of the separator." EX1016, ¶28. And as a result, "lithium dendrites caused by exposed

metal portions on the surface of the negative electrode layer are less likely to occur during charge-discharge cycles, resulting in a highly reliable organic electrolyte battery." EX1016, ¶28.

66. Shortly after Aoki and Fujikawa, in 2008, Kobayashi *et al*. (JP 2010-055906; EX1008) were developing a new insulating tape layer solution for lithium-ion batteries. Kobayashi developed a tape 25a for protecting the positive lead 11a attached to a recess (positive electrode core exposed portion 11f) formed in the positive active material 11b on a positive electrode plate 11. EX1008, ¶¶34-35, FIGs. 2A-2B. As shown, for example, in Figure 2A (reproduced below), adhesive paste 26 was selectively applied to Kobayashi's tape 25a such that the adhesive paste 26 covered the exposed portion 11f and the positive lead 11a. EX1008, ¶35. However, the adhesive paste 26 on Kobayashi's tape 25a did not extend over the positive active material 11b. EX1008, ¶35. Kobayashi described that, by limiting the location of the adhesive paste 26, undesirable "side reactions" between the adhesive paste and the positive electrode active material layer can be avoided. EX1008, ¶14.

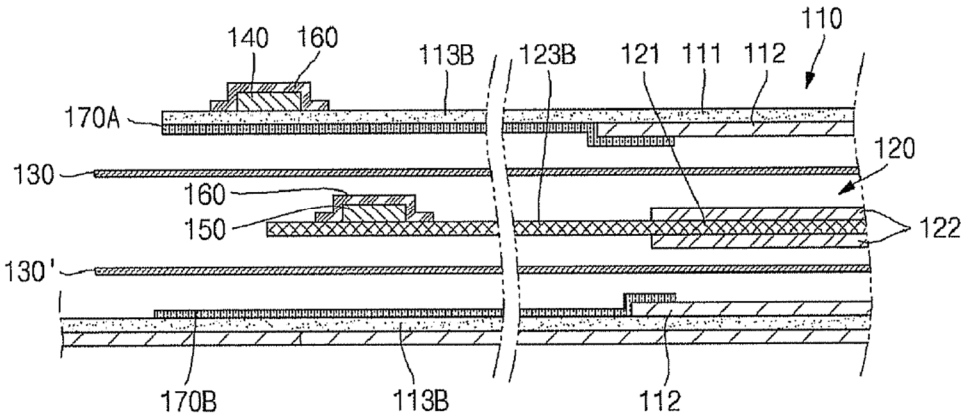



EX1008, FIG. 2A.

67. Kobayashi developed this improved tape solution because it was known that tape covering a positive lead and exposed metal within a recess was necessary to avoid short circuits at the recess. EX1008, ¶5. Kobayashi referred to these recesses as "steps (edges) between the regions in which the positive electrode or negative electrode active material layer is formed or not formed, and where the current collecting tabs are attached." EX1008, ¶5.

68. In 2009, Oh *et al*. (US 2010-0035144; EX1017) disclosed a lithium-ion battery with insulating tapes affixed on top of and below electrode tabs to prevent short circuits within the battery. EX1017, ¶¶[0030], [0031], [0037]-[0039]. As shown, for example, in Oh's Figure 4 (reproduced below), Oh disclosed a battery with a cathode plate 110, an anode plate 120, and a separator 130. EX1017, ¶[0025], FIGs. 3, 4. Oh's cathode plate 110 included a cathode collector 111, a cathode active material layer 112, uncoated cathode portions 113, and a cathode tab 140 fixed to one of the uncoated cathode portions 113. EX1017, ¶26. Oh's

anode plate 120 included an anode collector 121, an anode active material layer 122, uncoated anode portions 123, and an anode tab 140 fixed to one of the uncoated anode portions 123. EX1017, ¶27.



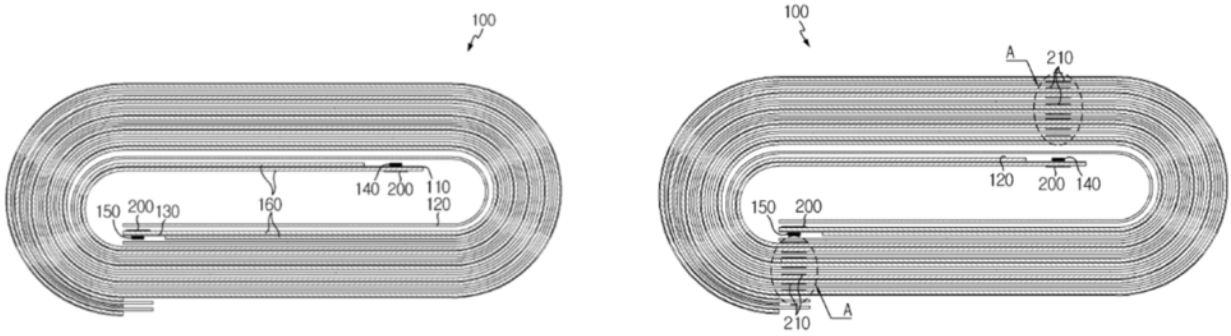

EX1017, FIG. 4.

69. A first protective tape 160 covered a top surface of the cathode tab 140 on a top surface of an uncoated cathode portion 113B, and a second laminating tape 170A covered the bottom surface of the uncoated cathode portion 113B below the cathode tab 140. EX1017, ¶¶[0037], [0038]. Oh's laminating tape 170A of the cathode plate 110 "corresponds to the outer surface of the rear anode uncoated portion 123B of the anode plate 120" to prevent "a short circuit that could be caused by contact between the rear cathode uncoated portion 113B of the cathode plate 110 and rear anode uncoated portion 123B of the anode." EX1017, ¶[0038].

70. Oh's battery also included a first protective tape 160 covering a top surface of the anode tab 150 on a top surface of an uncoated anode portion 123B,

and a second laminating tape 170B covering a top surface of the uncoated cathode portion 113B below the anode tab 150. EX1017, ¶¶[0037], [0039]. Oh's second laminating tape 170B "corresponds to the inner surface of the rear anode uncoated portion 123B of the anode plate 120" to prevent "a short circuit that could be caused by contact between the rear anode uncoated portion 123B of the anode plate 120 and rear cathode uncoated portion 113B of the cathode plate 110." EX1017, ¶[0039].

71. A few years later, in 2012, Lee *et al.* (KR 2013-0085202; EX1018) implemented insulation tapes with a coiled lithium-ion battery to avoid stress concentrations that could lead to cracking in the active material layers, and thus lead to short circuits. EX1018, ¶¶[0001], [0010], [0013], [0014], [0032]. As shown below in Lee's Figures 3 and 5, Lee's battery included a cathode current collector 110, a separator 120, and an anode electrode current collector 130. EX1018, ¶[0018]. Both sides of Lee's current collectors 110, 130 were coated with active material 160. EX1018, ¶[0018].



EX1018, FIGs. 3, 5.

72. Lee placed a tape 200 on the negative active material 160 opposite of the anode tab 150 to prevent cracking "caused by internal stress generated during a charging or discharging process." EX1018, ¶[0020]. Lee also placed tapes 210 on the positive active material layer 160 of multiple coiling layers opposite to the anode tab 150 across the separator 120 to avoid "a crack in the active material which may be caused in another coiling layer." EX1018, ¶[0028]. Similarly, Lee placed tape 200 on the positive active material 160 opposite of the cathode tab 140 to prevent cracking. EX1018, ¶[0020]. And Lee also placed tapes 210 on the positive active material layer 160 of multiple coiling layers opposite to the cathode tab 140 across the separator 120 to avoid cracks. EX1018, ¶[0028].

73. The following Table summarizes the location and stated purposes of the insulating materials in Exhibits 1006 and 1008-1018.

| Exhibit | 1st Named Inventor | Year | Location | Purpose |
|---|---|---|---|---|
| 1009 | Maejima | 1997 | between the negative electrode lead and the positive electrode | prevent lithium plating |
| 1010 | Yamauchi | 1997 | between the negative electrode lead and the positive electrode | prevent short circuits caused by electrical contact |
| 1006 | Takemura | 1998 | on the positive electrode active material opposite the negative electrode lead | prevent lithium plating |
| 1011 | Mizutani | 1999 | on the positive and negative electrode active materials opposite the negative and positive electrode leads | prevent short circuits caused by electrical contact |
| 1012 | Nakamura | 2001 | on the negative and positive leads | prevent internal short circuits |
| 1013 | Yoneda | 2005 | tape on the positive electrode lead, film on the negative electrode active material opposite the positive electrode lead | suppress heat generation during an internal short circuit |
| 1014 | Kwak | 2005 | on the separator, various locations | prevent short circuits caused by separator contraction |
| 1015 | Fujikawa | 2006 | on the positive or negative electrode lead, or on the positive or negative active material layer opposite the negative or positive electrode lead | prevent internal short circuits |
| 1016 | Aoki | 2007 | covering the positive electrode opposite exposed metal on the negative electrode | prevent lithium plating |
| 1008 | Kobayashi | 2008 | on the positive electrode lead | prevent internal short circuits |

| | | | | |
|---|---|---|---|---|
| 1017 | Oh | 2009 | on the positive electrode and negative electrode leads, and on uncoated portions of the positive electrode above and below the positive electrode and negative electrode leads | prevent internal short circuits |
| 1018 | Lee | 2012 | on the positive and negative active material layers opposite the negative and positive electrode leads | prevent stress concentrations that lead to cracking and short circuits |

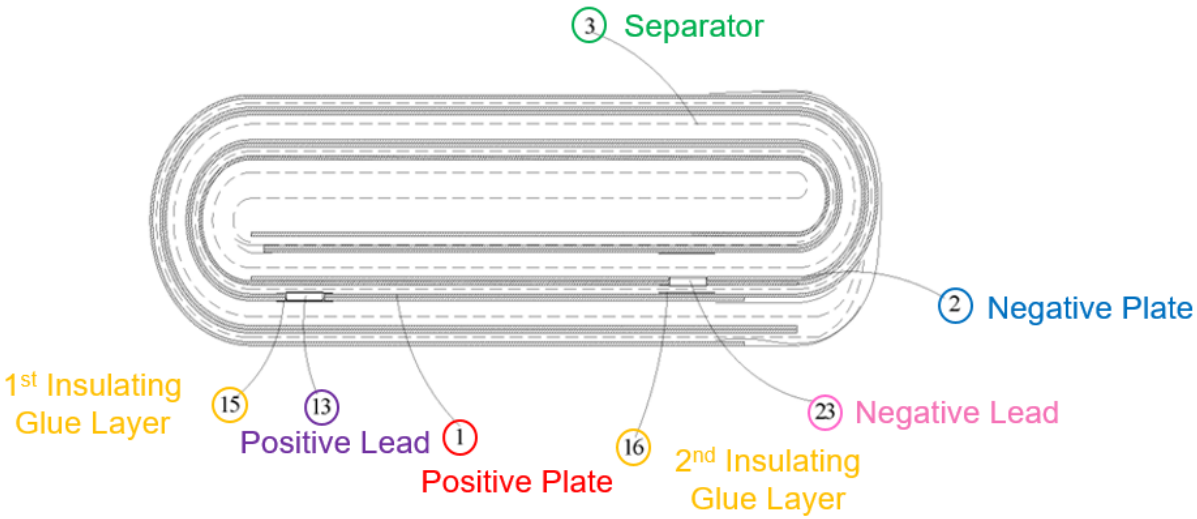
## VIII. ’498 PATENT

### A. Summary of the ’498 patent

74. The ’498 patent was filed as Application No. 17/746,755 on May 17, 2022. The ’498 patent is the third continuation in a chain of patents that claim priority to Chinese App. No. 201420030319.4. EX1001, cover (63). In particular, the ’498 patent is a continuation of pending Application No. 17/407,081, filed on August 19, 2021, which is a continuation of Application No. 16/113,938, filed on August 27, 2018 (now abandoned), which is a continuation of Application No. 14/596,873, filed on January 14, 2015 (now U.S. Patent No. 10,541,441). EX1001, 1:7-22.

75. The ’498 patent is titled “Lithium-ion Battery Having Desirable Safety Performance” and lists Tao and Ming Liang Mo as inventors. EX1001, cover page (54), (72).

76. The claims of the ’498 patent are directed to lithium-ion batteries. EX1001, 10:42-14:17. The ’498 patent discloses a lithium-ion battery that “includes a positive plate 1, a negative plate 2, a separator 3 disposed between the positive plate 1 and the negative plate 2, and electrolyte.” EX1001, 4:66-5:3.




EX1001, FIG. 5 (annotated).

77. The ’498 patent describes using insulating materials (e.g., insulating glue layers) to prevent internal battery short-circuiting and lithium precipitation (i.e., lithium plating) on the anode. EX1001, 1:62-2:3. The ’498 patent states that, by applying insulating layers within the battery, internal short-circuiting and lithium precipitation can be prevented. EX1001, 3:57-65. The ’498 patent seeks to prevent these internal short circuits and lithium precipitation by placing standard insulating layers in the battery coil. EX1001, 3:57-65.

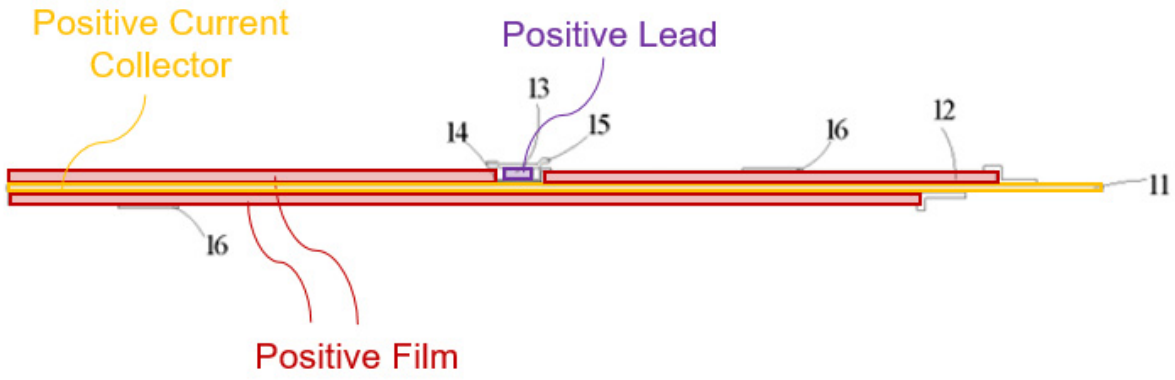
78. The ’498 patent claims and describes two different types of glue

layers: a first insulating glue layer and a second insulating glue layer. The first insulating glue layer 15 is applied to cover a recess 14 in the positive electrode plate 1 where a metal current collector 11 (e.g., aluminum foil) is exposed for connection with a positive lead 13. EX1001, 4:38-5:23. The second insulating glue layer 16 is applied to the positive active material film 12 on the positive electrode plate 1 across from a second recess 24 in the negative electrode plate 2 where a metal current collector 21 (e.g., copper foil) is exposed for connection with a negative lead 23. EX1001, 4:38-5:23. The use of insulating layers as described in the '498 patent was a common technique employed in the industry to address the well-known problem of lithium plating and short-circuting. As I discussed in Section VII, many prior-art references addressed these common issues using the same solutions. *See* EX1009, ¶¶[0007]-[0008], [0013]; EX1006, ¶[0008]; EX1011, ¶[0044]; EX1012, ¶¶[0052]-[0053]; EX1015, ¶¶[0017]-[0118]; EX1016, ¶[0028]; EX1008, ¶[0005]; EX1017, ¶¶[0037]-[0039].

79. According to the '498 patent, when "there is no insulating layer provided on the positive area corresponding to the positive recess or the negative recess, internal short circuit and lithium precipitation may potentially occur to the lithium-ion battery, which will inevitably affect the safety performance of the lithium-ion battery." EX1001, 1:65-2:3.

80. Figures 1 and 2 below depict the '498 patent's positive electrode plate

structure. The "positive plate 1 includes a positive current collector 11, a positive film 12 provided on the positive current collector 11, and a positive lead 13," shown below. EX1001, 5:3-5. Positive film 12 is provided on both sides of positive current collector 11. A portion of positive current collector 11 is exposed by "defin[ing] a first recess 14" in positive film 12. EX1001, 5:7-8. The positive lead 13 is connected to the positive current collector 11 via a recess 14 in the positive film 12. A first insulating glue layer 15 is applied over the positive lead 13, recess 14, and positive film 12. EX1001, 5:11-14. A second insulating glue layer 16 is applied to the positive electrode shown in Figure 2 at a point corresponding to the negative lead connection to the negative electrode (Figure 5 above). EX1001, 5:14-5:17.



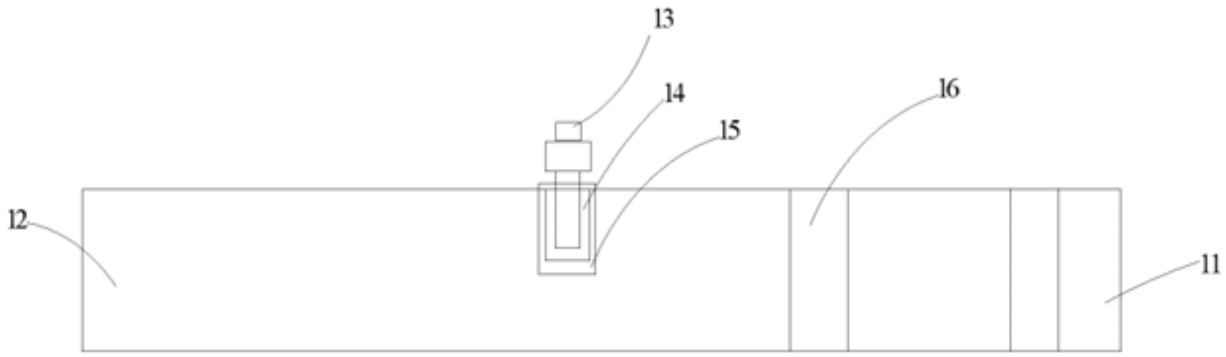



**FIG. 2**

EX1001, FIGs. 1, 2.

81. Figures 3 and 4 below depict the ’498 patent’s negative electrode plate structure. “[N]egative plate 2 includes a negative current collector 21, a negative film 22 provided on the negative current collector 21, and a negative lead 23,” shown below. EX1001, 5:5-8. Negative film 22 is provided on both sides of negative current collector 21. A portion of negative current collector 21 is also exposed by “defin[ing] a second recess 24” in negative film 22. EX1005, 5:8-10. A negative lead 23 is connected to the negative current collector 21 via a recess 24 in the negative film 22. EX1001, 5:12-17.

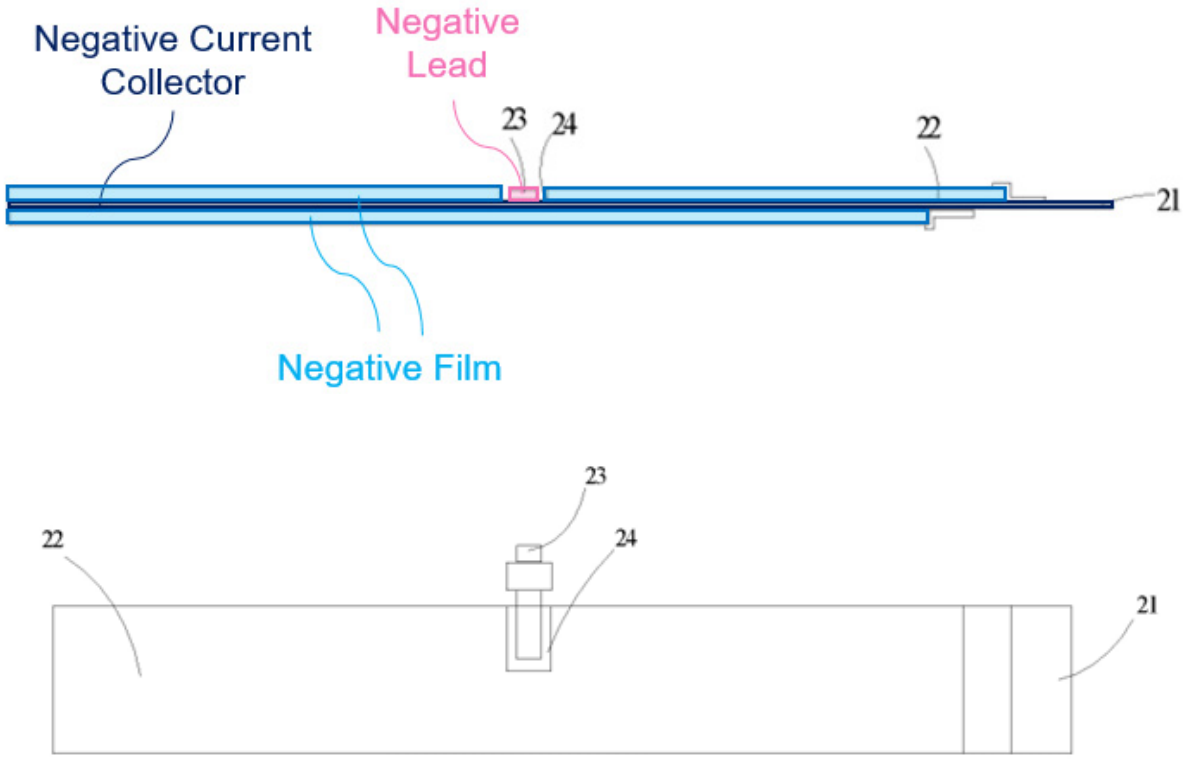



**FIG. 4**

EX1001, FIGs. 3, 4.

82. The ’498 patent also describes positioning the recesses 14, 24 away from the ends of the current collector 1, 2. The recesses 14, 24 are positioned at a midpoint of their respective electrode plates. EX1001, 5:24-33.

83. When the current collectors 1, 2 are coiled in the ’498 patent’s battery cell, one or more second insulating glue layers 16 are located at a position corresponding to the second recess 24 across the separator 3, as shown in Figure 5 above. The ’498 patent explains that the second insulating glue layer(s) 16 have a width larger than a width of the second recess 24, and a length larger than a length

of the second recess 24. EX1001, 3:9-12.

**B. Prosecution History of the ’498 patent**

84. The application that issued as the ’498 patent was filed as a Track 1 (expedited examination) application on May 17, 2022 with 19 original claims, all directed to a lithium-ion battery. EX1002, 1-4, 37-42.

85. The US Patent and Trademark Office (“the Office” or “USPTO”) issued a first non-final office action on July 28, 2022 rejecting claims 1-9 as obvious over PCT Pub. No. WO 2013/038677 to Sugita in view of U.S. Pub. No. 2014/0120417 to Matsushita and U.S. Pub. No. 2006/0051662 to Kwak. EX1002, 82-98. The Office stated that all limitations of claim 1 were disclosed by Sugita except the originally claimed first and second insulating glue layers. EX1002, 85-87. The Office stated that Matsushita and Kwak disclose insulating glue layers (particularly, a resin tape (Matsushita) and insulation tape (Kwak)). EX1002, 87. And based on Matsushita’s and Kwak’s disclosures, the Office found that it would have been obvious to modify Sugita to arrive at a lithium-ion battery as recited in original claim 1. EX1002, 87-88.

86. Using a similar rationale, claims 10-17 and 19 were rejected as obvious over Sugita in view of Matsushita. EX1002, 91-96. And finally, claim 18 was rejected as obvious over Sugita in view of Matsushita and U.S. Pub. No. 2011/0027636 to Lee. EX1002, 96-97.

87. An Examiner interview was conducted on August 5, 2022. EX1002, 173. The applicant noted that claims 1-19 were filed by mistake, as they were the same claims filed in co-pending application 17/407,081. EX1002, 173.

88. On August 8, 2022, in reply to the July 28, 2022 Office Action, the applicant canceled claims 1-19 and added new claims 20-39. EX1002, 168-172. No detailed substantive arguments were presented.

89. The USPTO issued a Final Office Action on October 24, 2022, reiterating the rejections over Sugita in view of Matsushita and Kwak of originally filed claims 1-19 for new claims 20-39. EX1002, 179-200.

90. In reply to the Final Office Action of October 24, 2022, the applicant filed a request for continued examination (RCE) and substantive reply on January 24, 2023. EX1002, 265. The applicant amended independent claim 20 to recite "a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer." EX1002, 271. Independent claims 29 and 37 were similarly amended. EX1002, 273, 275. The applicant argued these amendments overcame the rejections. EX1002, 276-283.

91. The USPTO then issued a Non-final Office Action on March 31, 2023, rejecting pending claims 20-27 and 37-39 over Sugita in view of Matsushita and further in view of Japanese App. No. 2007/156224 to Atsuo. EX1002, 297-

321. The Office stated that Atsuo discloses the new limitation added to the claims in the January 24, 2023 reply. EX1002, 303. And based on Atsuo's disclosure, the Office found that it would have been obvious to modify the combination of Sugita and Matsushita in view of Atsuo to arrive at the claimed batteries. EX1002, 304-305, 310-311.

92. An Interview Summary provided by the Examiner on May 11, 2023 indicated that an interview with the applicant's representative took place on May 4, 2023. EX1002, 371-372. The Interview Summary stated that the parties discussed a draft declaration from a co-inventor of the '498 patent named Tao Tao and that "the arguments presented at section 7 of the declaration could advance prosecution if accompanied by amendment." EX1002, 372. The Examiner suggested "to advance prosecution by requiring the positive electrode does not include an insulating glue layer across the separator." EX1002, 372. The Interview Summary also stated that "Applicant's counsel followed-up the interview with proposed claim language." EX1002, 372. The Examiner indicated, "the proposed claim language would overcome the rejection of record and advance prosecution. See attachments." EX1002, 372. The Examiner attached what appears to be a proposed amendment from the applicant, including an amendment to claim 20 shown below.

> wherein, a top surface of the positive lead is provided with a first insulating glue layer, a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer, the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of the second recess, and there is no insulating glue layer disposed on the surface of the negative electrode active material layer opposite to the second lead across the separator in the thickness direction of the positive plate and the negative plate.

EX1002, 374.

93. Notably, this amendment was **not included** with the subsequent reply from the applicant.

94. In reply to the Non-final Office Action of March 31, 2023, the applicant filed a response on June 29, 2023, accompanied by the declaration from inventor Tao, which amended formalities in claims 29 and 38 and added new claims 40-42. EX1002, 387-405. These amendments did not affect the applicant's arguments for the independent claims. And the independent claims were not amended. EX1002, 389-393. In connection with the declaration from inventor Tao, the applicant argued that Atsuo's disclosure fails to recite a second insulating glue layer disposed on the positive electrode adjacent to the negative lead connection. EX1002, 395-398.

95. On September 7, 2023, the Office allowed Application No. 17/746,755. EX1002, 408-414. The Examiner stated that the cited prior art failed to disclose "the variable of width relationship as shown in the claims, as well as the

lack of teaching or suggestion that the insulating glue layer being applied to both active layers as shown in the claims." EX1002, 413. Interestingly, the Office's comment that the cited art lacked "teaching or suggestion that the insulating glue layer being applied to both active layers as shown in the claims" is not consistent with the claims granted in the '498 patent. The '498 patent claims do not recite an insulating glue layer applied to the negative active layer. All the claimed insulating glue layers are applied to the positive electrode.

96. The '498 patent subsequently issued on March 5, 2024. EX1002, 509-510.

### C. '498 patent Claims

97. Independent claims 1, 9, and 17 are reproduced below.

> **1.** A lithium-ion battery, comprising:
>
> a positive electrode comprising a positive current collector and a positive electrode active material layer containing $LiCoO_2$, wherein the positive electrode active material layer is formed on the positive current collector, the positive electrode active material layer being provided with a first recess accommodating a positive lead being coupled with the positive current collector;
>
> a negative electrode comprising a negative current collector and a negative electrode active material layer containing graphite or silicon, wherein the negative electrode active material layer is formed on the negative current collector, the negative electrode active material layer being provided with a second recess accommodating a negative lead being coupled with the negative current collector;

a separator disposed between the positive electrode and the negative electrode; and

an electrolyte,

wherein, a top surface of the positive lead is provided with a first insulating glue layer, a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer, the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of the second recess.

**9.** A lithium-ion battery, comprising:

a positive electrode, comprising a positive current collector and a positive electrode active material layer being formed on the positive current collector, the positive electrode active material layer being provided with a first recess accommodating a positive lead being coupled with the positive current collector;

a negative electrode, comprising a negative current collector and a negative electrode active material layer being formed on the negative current collector, the negative electrode active material layer being provided with a second recess accommodating a negative lead being coupled with the negative current collector;

a separator disposed between the positive electrode and the negative electrode; and

an electrolyte,

wherein, a first location of a top surface of the positive lead is provided with a first insulating glue layer; a second location of a surface of the positive electrode active material layer opposite to the second recess across

the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer; a third location of a surface of the positive current collector opposite to the surface of the positive current collector where the positive lead is covered with another first insulating glue layer; the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of the second recess.

**17.** A lithium-ion battery, comprising:

a positive electrode, comprising a positive current collector and a positive electrode active material layer being formed on the positive current collector, the positive electrode active material layer being provided with a first recess accommodating a positive lead being coupled with the positive current collector;

a negative electrode, comprising a negative current collector and a negative electrode active material layer being formed on the negative current collector, the negative electrode active material layer being provided with a second recess accommodating a negative lead being coupled with the negative current collector;

a separator disposed between the positive electrode and the negative electrode; and

an electrolyte,

wherein, a first location of a top surface of the positive lead is provided with a first insulating glue layer; a second location of a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer; the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of

the second recess.

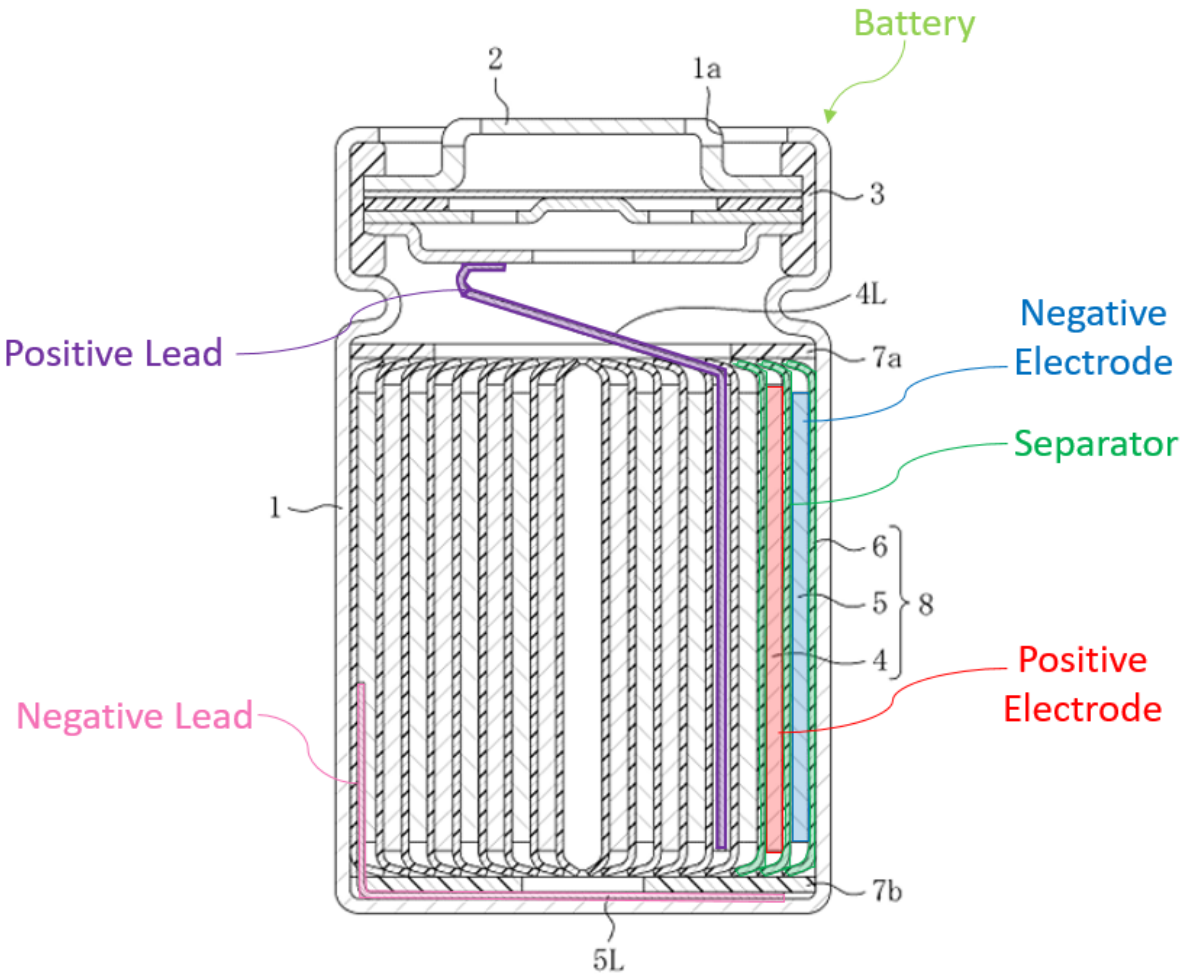
## IX. GROUND 1: CLAIMS 1-3, 6, 8, 17, AND 19 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO IN COMBINATION WITH TAKEMURA.

### A. U.S. Patent Pub. No. 2011/0111276 to Sato *et al.* (Sato)

98. U.S. Patent Pub. No. 2011/0111276 to Sato *et al.* is a national entry of PCT/JP2010/002663, filed on April 13, 2010, and published on May 12, 2011. Sato's publication date precedes the '498 patent's earliest effective filing date of January 17, 2014 by almost three years, and its international filing date precedes the '498 patent's filing date by almost four years.

99. Sato discloses a Li-ion battery containing the same materials as claimed in the '498 patent. EX1005, ¶¶[0027], [0047]- [0098]. Sato's battery "includes a battery case 1" and "an electrode group 8 housed in the battery case 1." EX1005, ¶[0028]. As shown in Figure 1, reproduced below, Sato's "electrode group 8 includes: a positive electrode plate 4; a negative electrode plate 5; and a porous insulating layer (i.e., a separator) 6." EX1005, ¶[0030]. Sato's positive electrode plate 4 and negative electrode plate 5 "are wound [in] a spiral with the separator 6 interposed therebetween." EX1005, ¶[0030]. Sato's battery includes a positive electrode lead 4L "attached to the positive electrode plate 4" and "to the sealing plate 2" to "serv[e] as a positive electrode terminal." EX1005, ¶[0031]. Sato's battery also includes a negative electrode lead 5L "attached to the negative

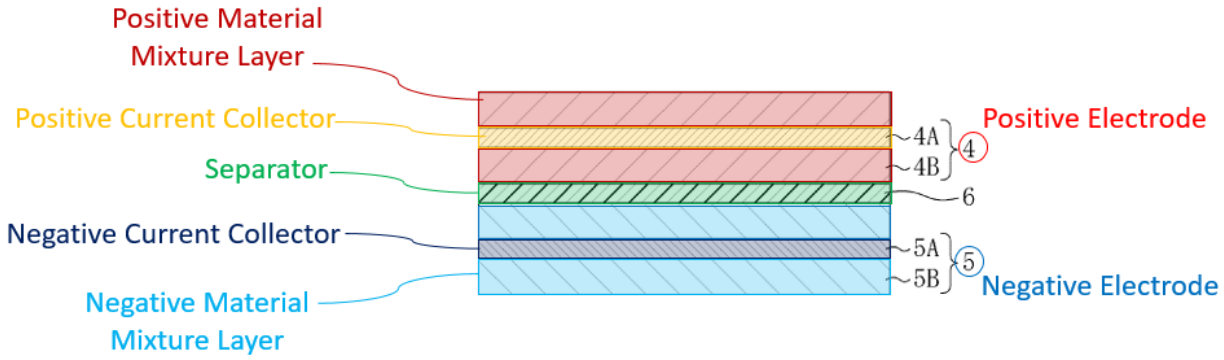
electrode plate 5" and "to the battery case" to "serv[e] as a negative electrode terminal." EX1005, ¶[0031].




EX1005, FIG. 1 (annotated).

100. As shown in Figure 2, reproduced below, Sato's "positive electrode plate 4 includes a positive electrode current collector 4A and a positive electrode material mixture layer 4B." EX1005, ¶[0033]. Sato's "positive electrode material mixture layer 4B is provided on each surface of the positive electrode current collector 4A," which "is a conductive foil member." EX1005, ¶¶[0033], [0051].

Sato's positive electrode material mixture layer 4B contains an active material, such as lithium composite oxide, a binder, and a conductive agent. EX1005, ¶[0033].

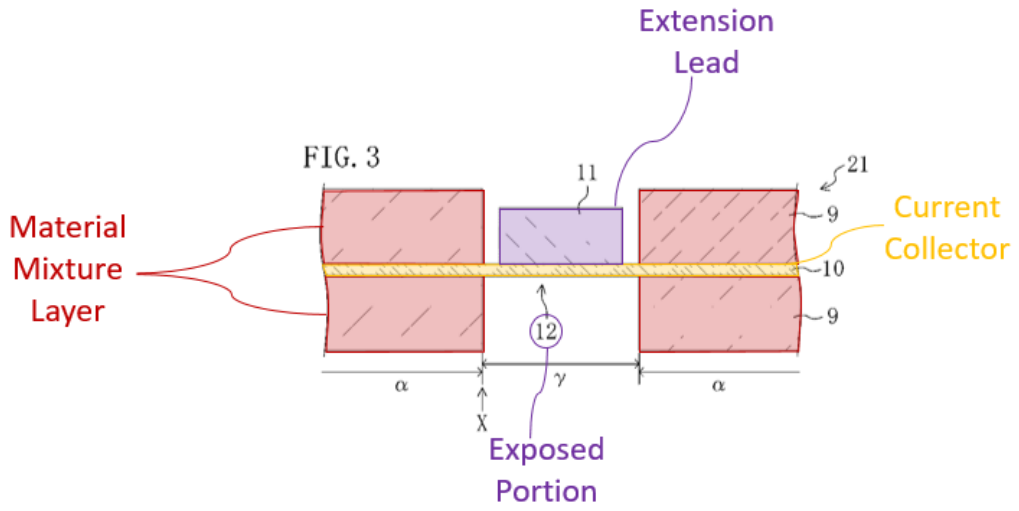



EX1005, FIG. 2 (annotated).

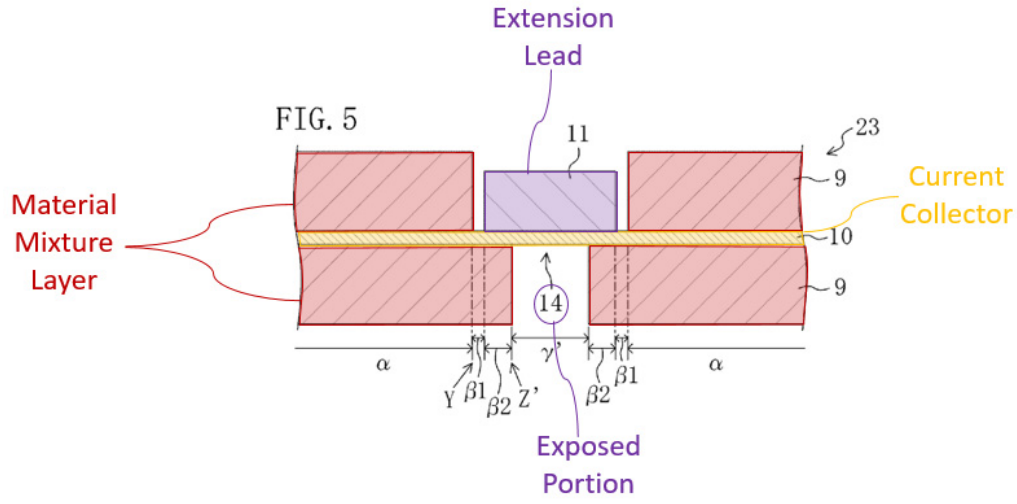
101. Sato's "negative electrode plate 5 includes a negative electrode current collector 5A and a negative electrode material mixture layer 5B." EX1005, ¶[0034]. Sato's "negative electrode material mixture layer 5B is provided on each surface of the negative electrode current collector 5A," which "is a conductive foil member." EX1005, ¶[0034]. Sato's negative electrode material mixture layer 5B contains an active material, such as graphite or silicon, and a binder. EX1005, ¶¶[0034], [0066].

102. Sato's positive electrode current collector 4A and the negative electrode current collector 5A include an "exposed portion" 12/14, which "is not provided with the [electrode material] mixture layer." EX1005, ¶¶[0036], [0041]. Sato's positive lead 4L is welded to the "exposed portion" 12/14 of Sato's positive

electrode current collector 4A. Similarly, Sato's negative lead 5L is welded to the "exposed portion" of Sato's negative electrode current collector 5A. Figures 3 and 5 of Sato, reproduced below, illustrate this concept of connecting an extension lead 11 to one of the surfaces of an exposed portion 12/14 of a current collector 10. EX1005, ¶¶[0038]- [0041]. A POSA would have understood that the arrangement of mixture layer 9 and extension lead 11 on current collector 10 shown in Figures 3 and 5 is representative of the mixture layer and lead on the current collector of positive electrode plate 4 shown in Figure 2 (for example, the positive electrode of Sato's Battery 1) ***and*** representative of the mixture layer and lead on the current collector of negative electrode plate 5 shown in Figure 2 (for example, the negative electrode of Sato's Battery 8). EX1005, ¶¶[0101-[0113], [0136]-[0137]. A POSA would understand that this arrangement is suitable for both positive and negative electrodes and that combining them would reduce the "current collection resistance." EX1005, ¶24.




EX1005, FIG. 3 (annotated).




EX1005, FIG. 5 (annotated).

103. Sato further describes protecting and insulating the leads 11 with polypropylene and polyethylene adhesive tapes. EX1005, ¶[0113]. Sato also discloses placing an additional insulating tape on "the positive electrode surface facing the negative electrode lead . . . in order to prevent lithium deposition." EX1005, ¶[0137]. According to Sato, this additional insulating tape is attached to a

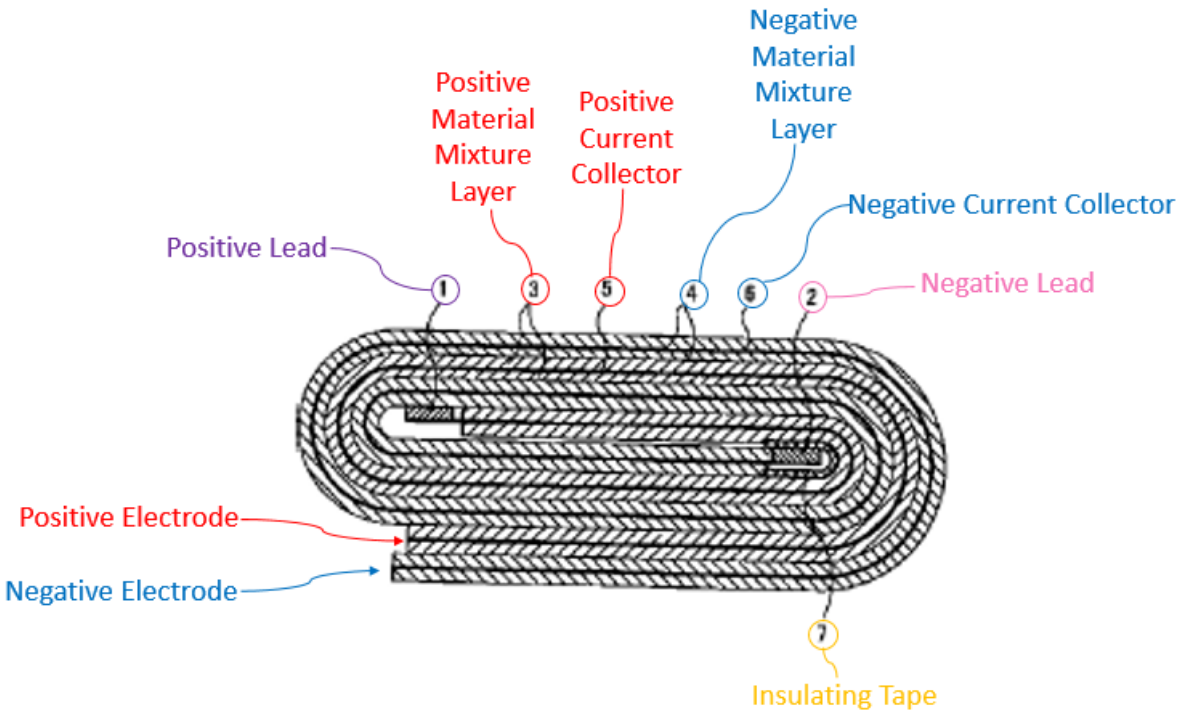
portion of the positive electrode active layer (4B/9). EX1005, ¶[0148] (explaining that "a portion of the positive electrode active material which should originally operate is insulated by a tape").

### B. Japanese Patent Pub. No. JP 2006-067907 to Takemura *et al.* (Takemura)

104. Japanese Patent Pub. No. 2000-067907 to Takemura *et al.* published on March 3, 2000. Takemura's publication date precedes the '498 patent's earliest effective filing date of January 17, 2014 by almost 14 years.

105. Takemura discloses a "lithium ion secondary battery" similar to those described in Sato and the '498 patent. EX1006, ¶[0003]. Takemura's lithium-ion battery includes a positive electrode formed by a positive electrode current collector 5 and a positive electrode active material 3 provided on the surfaces of positive current collector 5. EX1006, ¶[0003]. Takemura's lithium-ion battery also includes a negative electrode formed by a negative electrode current collector 6 and a negative electrode active material 3 provided on the surfaces of negative current collector 6. EX1006, ¶[0003]. Takemura's battery includes a separator (annotated in Figure 8 below) impregnated with a non-aqueous electrolyte and interposed between the positive electrode active material 3 and negative electrode active material 4. EX1006, ¶[0003]. Takemura's lithium-ion battery further includes a positive electrode current collector terminal (lead) 1 connected to the positive current collector 5 and a negative electrode current collector terminal

(lead) 2 connected to the negative current collector 6. Takemura's positive electrode current collector terminal (lead) 1 and negative electrode current collector terminal (lead) 2 carry current to and from the positive current collector 5 and the negative current collector 6. Takemura's positive electrode current collector terminal (lead) 1 and negative electrode current collector terminal (lead) 2 can be attached to the positive current collector 5 and the negative current collector 6, respectively via welding. EX1006, ¶[0007].




EX1006, FIG. 9 (annotated).

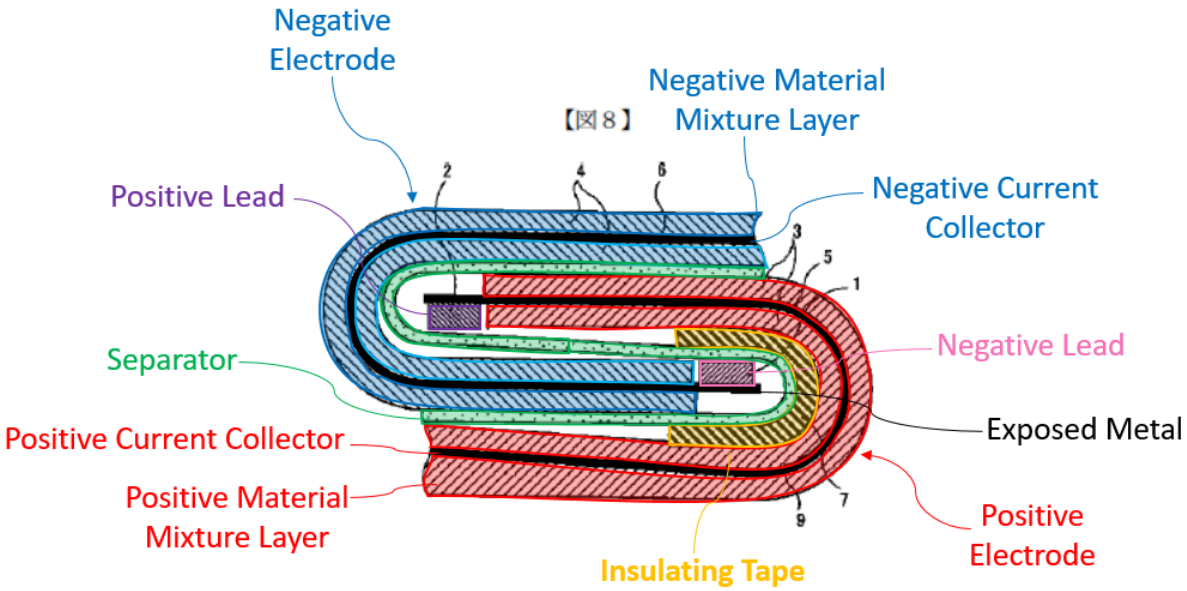
106. Takemura discloses similar fabrication attributes as Sato and the '498 patent, such as applying the active-material slurries on the current collector foils and spirally winding the positive and negative electrodes within a battery case.

EX1006, ¶[0005]. Takemura also discloses exposing portions of the positive and negative current collectors 5 and 6 where the positive electrode current collector terminal (lead) 1 is connected to positive current collector 5 and negative electrode current collector terminal (lead) 2 is connected to negative collector 6. EX1006, ¶[0006].

107. Takemura further discloses placing an insulating tape 7 on the positive electrode active material layer 3 adjacent to a negative electrode current collecting lead 2 and bare, exposed portions of the negative current collector 6. EX1006, ¶[0003], FIG. 9. Takemura explains that the presence of the insulating tape 7 around the negative lead 2 is a conventional method of preventing lithium plating on the exposed metal of the negative current collector 6 where the negative lead 2 is attached. EX1006, ¶[0008]. Takemura's Figure 8 (reproduced below) shows an enlarged view of the structure shown in Figure 9, with a separator (not numbered) located between the positive electrode and the negative electrode.[3] As illustrated in both Takemura's Figure 8 and Figure 9, the insulating tape 7 is sized such that it overlaps all the exposed metal on the negative current collector 6 and the edge of

[3] Takemura mislabels the positive lead 1 and the negative lead 2 in Figure 8. The lead labeled "1" should be labeled "2" and the lead labeled "2" should be labeled "1."

the negative active material 4 adjacent to the negative lead 2. Takemura sized the tape 7 to overlap all of the exposed metal on the negative current collector 6 to prevent lithium plating on the exposed anode foil and tab. If Takemura's tape 7 were sized to have an area less than the area of the exposed metal, lithium plating would occur on the exposed metal, thereby defeating the intended purpose of the tape 7.




EX1008, FIG. 8 (annotated).

### C. A POSA would have been motivated to combine Sato and Takemura with a reasonable expectation of success.

108. Sato and Takemura are analogous art as they both disclose coiled lithium-ion battery cells. EX1005, ¶[0001]; EX1006, ¶[0001]. Both Sato and Takemura disclose non-aqueous electrolyte coiled lithium-ion battery cells with insulating tapes configured to enhance reliability and prevent safety hazards within

the battery cells. EX1005, ¶¶[0010], [0113]; EX1005, ¶[0003].

109. Sato discloses insulating tapes configured to protect the positive and negative leads and an additional insulating tape configured to prevent lithium plating. EX1005, ¶[0113], [0120]. Relatedly, Takemura discloses insulating tape configured to overlap exposed portions of a negative current collector to prevent lithium plating. EX1006, ¶[0008].

110. Lithium plating within lithium-ion batteries was a known problem well before the filing date of the '498 patent. *See, e.g.*, EX1009, ¶[0002]; EX1016, ¶[0010]; EX1019, 1318; EX1021, 242; EX1022, 47; EX1023, 201. Lithium plating tends to produce dendritic deposits which can penetrate the separator, thereby connecting the positive and negative electrodes and short-circuiting the battery. EX1023, p. 201. Lithium plating is particularly likely where exposed metal on the negative electrode is opposite positive active material. EX1009, ¶[0003]; EX1022, 51 (illustrating that exposed metal opposite to positive electrode active material is susceptible to lithium plating).

111. Solutions for preventing lithium plating on the exposed metal around the negative lead were also known well before the earliest possible priority date of the '498 patent. EX1009, ¶[0017] ("[L]ithium ion migration between the negative electrode side lead wire connection and the positive electrode plate can be prevented by a lithium ion migration preventing insulator"); EX1006, ¶[0021]

("[T]he winding end of the negative electrode is covered with insulating tape 7 to prevent lithium metal deposition"); EX1016, ¶[0014] ("This aspect of the present invention provides an organic electrolyte battery that can prevent lithium dendrite precipitation due to exposed metal portions on the surface of the negative electrode layer."). Sato and Takemura use one of the primary solutions—selectively applying an insulating tape on the positive active material opposite exposed metal on the negative electrode. EX1005, ¶¶[0113], [0137]; EX1006, ¶[0008]. Both Sato and Takemura disclose placing an insulating tape on the positive active material across the battery's separator at a location corresponding to the location of the negative lead and exposed metal on the negative current collector to prevent lithium plating. EX1005, ¶ [0137]; EX1006, ¶¶[0008], [0022].

112. To the extent that Sato does not explicitly disclose all the claimed features of the '498 patent's second insulating layer, it would have been obvious to a POSA to locate Sato's insulating tape, as taught by Takemura, opposite to the negative lead connection on Sato's negative lead. EX1006, ¶[0008]. Such modification would have ensured that Sato's negative lead 5L and adjacent exposed metal in Sato's recess (exposed portion 12) were protected from undesirable lithium plating, even when Sato's battery is exposed to conditions that promote lithium plating, such as rapid charging. EX1009, ¶[0017] ("[E]ven if the potential of the negative electrode plate falls below the lithium deposition potential

during rapid charging, etc., lithium can be kept from being deposited at the negative electrode side lead wire connection of the negative electrode current collector."). A POSA would have been motivated to combine the teachings of these references, in part because both references recognize safety and reliability issues associated with Lithium plating, and both references address these issues by strategic positioning of insulating tapes. EX1005, ¶[0137]; EX1006, ¶[0008].

113. A POSA would also have had a reasonable expectation of success in combining the teachings of Sato and Takemura. Insulating tapes were common in coiled lithium-ion battery cells well before 2014. *See* EX1006, ¶¶3, 8, 22; *see also* EX1009, ¶8; EX1010, ¶29; EX1011, ¶18. What is more, insulating tapes were specifically used to help prevent lithium plating in coiled lithium-ion batteries. EX1009, ¶8; EX1016, ¶10. A POSA would have expected Takemura's insulating tape, incorporated into Sato's battery, to perform its intended function of preventing lithium plating on the exposed negative foil and tab. A POSA would have also understood that locating the second insulating tape on the portion of Sato's positive electrode active material opposite the negative lead connection does not obstruct the remaining majority of Sato's positive electrode. Accordingly, combining Takemura's insulating tape with Sato's battery would have amounted to nothing more than applying a known technique (locating insulating tape on positive electrode active material surface opposite to negative lead connection) to a

known device (Sato's battery) to yield the predictable result of preventing Lithium plating at a known position for a known benefit. Furthermore, the Sato-Takemura combination would have simply been combining known elements (Sato's positive electrode and Takemura's insulating tape) according to known methods (adhering the insulating tape to positive electrode active material surface opposite to negative lead connection) to yield the predictable result of preventing lithium plating.

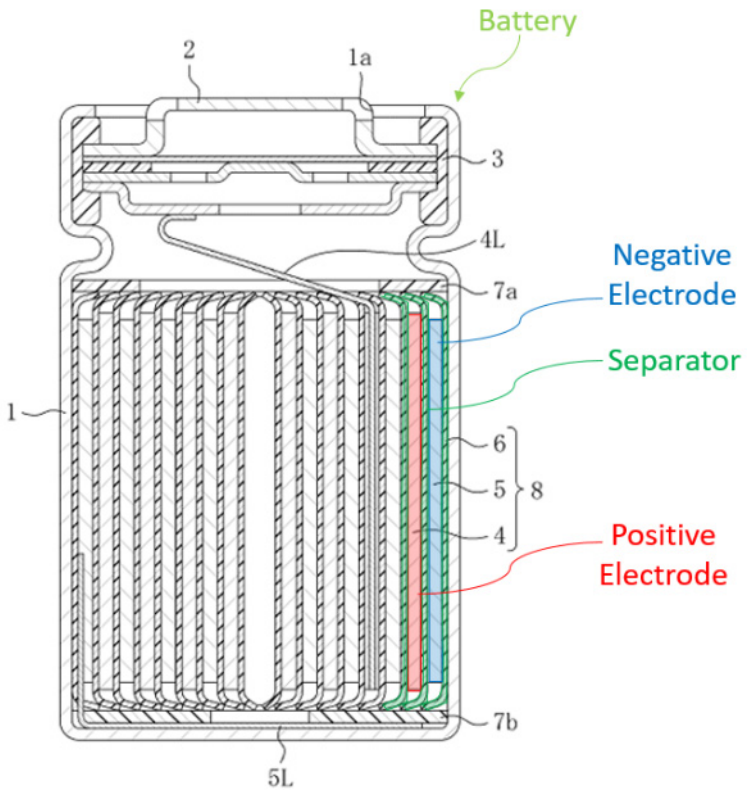
### D. The combination of Sato and Takemura discloses or renders obvious every element of claims 1-3, 6, 8, 17, and 19.

114. The following explains how each claimed element of the '498 patent is disclosed by Sato and/or Takemura. In view of Sato's and Takemura's disclosures, a POSA would have modified Sato in view of Takemura to arrive at lithium-ion batteries as claimed in the '498 patent.

#### 1. [1.P] A lithium-ion battery, comprising:

115. Sato discloses a lithium-ion battery. EX1005, ¶[0027] and FIG. 1. Sato discloses various examples of lithium-ion batteries, including Batteries 1-11 described in paragraphs [0099]-[0143]. Electrodes having dimensions according to the electrodes in Sato's Battery 1 and Battery 8 are referred to herein for context. Sato discloses that (i) the positive electrode (for example, the positive electrode of Battery 1) can have a recess for accommodating a positive lead, (ii) the negative electrode (for example, the negative electrode of Battery 8) can have a recess for accommodating the negative lead, or (iii) both the positive electrode and the

negative electrode can have a recess for accommodating the positive lead and the negative lead, respectively. EX1005, ¶[0094] (explaining that both leads 4 and 5 can be attached to the electrodes at a location ranging from ¼ to ¾ the length of the electrode). According to Sato, "[i]t is sufficient that at least one of the positive electrode and the negative electrode satisfies the above conditions for the lead attachment position. EX1005, ¶[0094]. A POSA would have interpreted the language of "at least one" in paragraph [0094] within the context of Sato's disclosure to cover "the positive electrode and/or the negative electrode." As evidenced by at least U.S. Patent Pub. No. 2011/0104539 (EX1007), this was a known construction for both positive and negative leads at the time of Sato's filing date. Accordingly, a POSA would have understood that Sato discloses a lithium-ion battery. And more specifically, a POSA would have understood that Sato discloses a lithium-ion battery with positive and negative electrodes each having a recess for accommodating the respective lead.

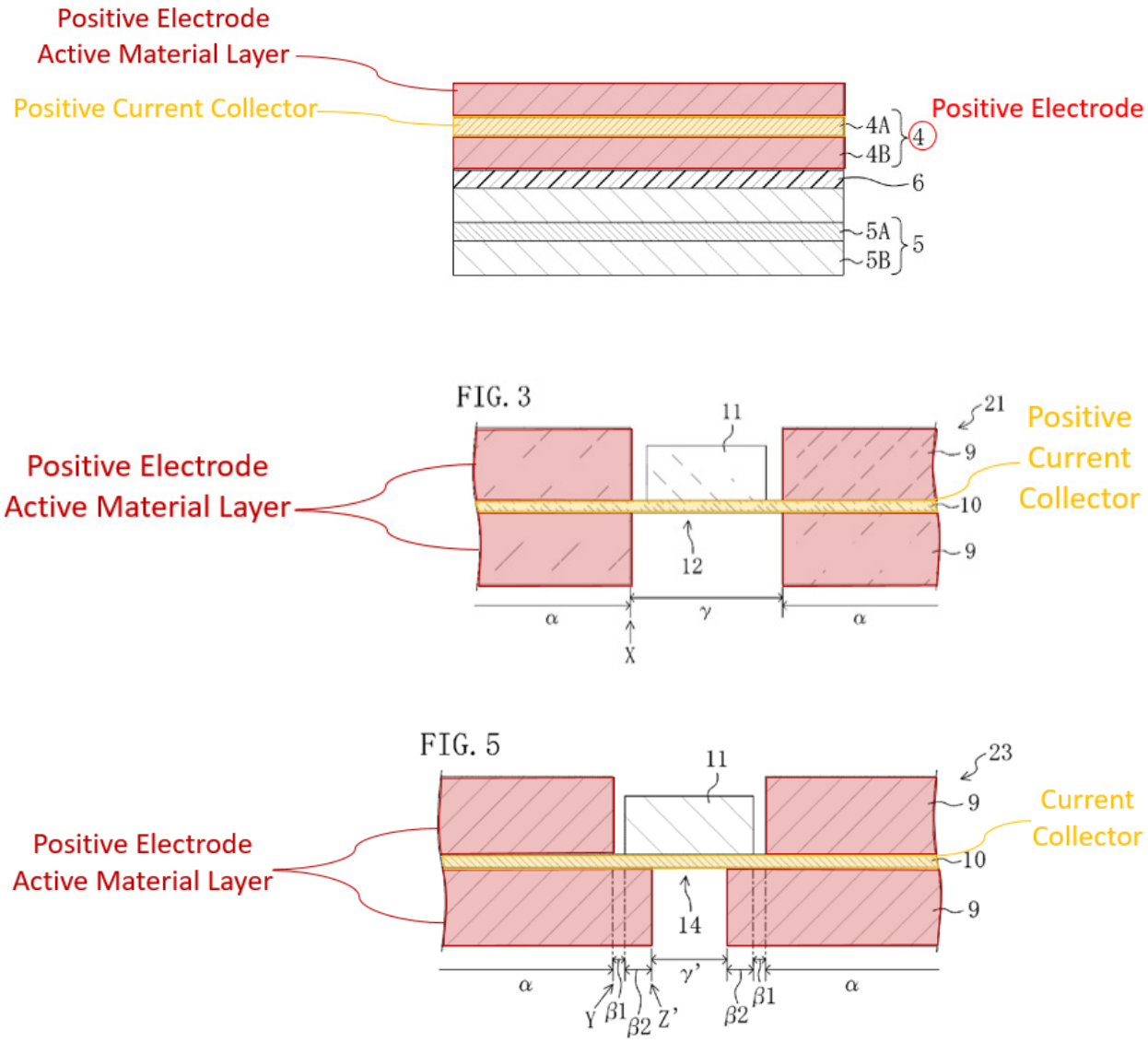



EX1005, FIG. 1 (annotated).

**2. [1.A] a positive electrode comprising a positive current collector and a positive electrode active material layer containing $LiCoO_2$, wherein the positive electrode active material layer is formed on the positive current collector,**

116. Sato discloses a positive electrode (plate 4) with a positive current collector (collector 4A/10) and a positive electrode active material layer (layer 4B/9) made of a lithium composite oxide formed on the positive current collector (collector 4A/10). EX1005, ¶¶[0030] and [0033], FIGs. 2, 3, 5. Sato also discloses that the positive active material layer can be made with lithium cobalt oxide ($LiCoO_2$). EX1005, ¶[0051]; *see also* EX1006, ¶[0003], FIG. 9 (disclosing a positive electrode including a positive current collector 5 and positive electrode

active material layer 3).




EX1005, FIGs. 2, 3, 5 (annotated).

117. When assembled, Sato's battery includes a positive electrode plate 4, a negative electrode plate 5, and a separator 6 made of, for example, polyethylene. EX1005, ¶[0030]. The positive electrode plate 4 and the negative electrode plate 5

are wound in a spiral with the separator 6 interposed between them. EX1005, ¶[0030].

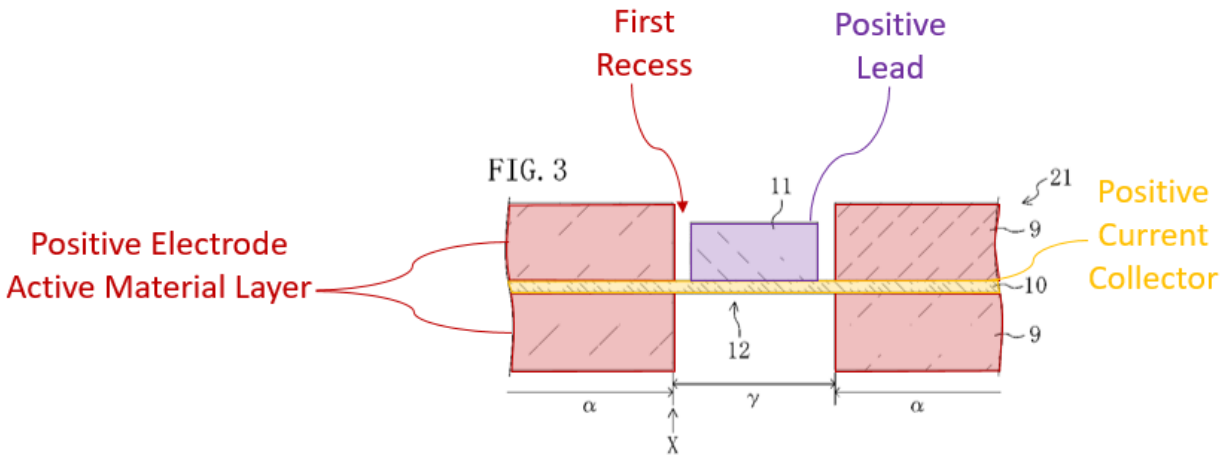
118. As illustrated in Figure 2, for example, and explained by Sato, "the positive electrode plate 4 includes a positive electrode current collector 4A and a positive electrode material mixture layer 4B." EX1005, ¶[0033]. Sato's positive electrode current collector 4A "is in the shape of a band, and is a conductive foil member," such as an aluminum foil. EX1005, ¶[0033]. Sato's positive electrode material mixture layer 4B is "provided on each surface of the positive electrode current collector 4A, contains a positive electrode active material (e.g., lithium composite oxide) and a binder, and preferably contains a conductive agent." EX1005, ¶[0033]. A POSA would have understood that Sato's positive electrode 4 corresponds to the recited "positive electrode" because Sato's lithium cobalt oxide material mixture layer 4B is a common positive electrode active material for lithium-ion batteries that allows for efficient lithium ion intercalation and deintercalation during charging and discharging. EX1023, 199.

119. Accordingly, a POSA would have understood that Sato discloses Element [1.A].

### 3. [1.B] the positive electrode active material layer being provided with a first recess accommodating a positive lead being coupled with the positive current collector;

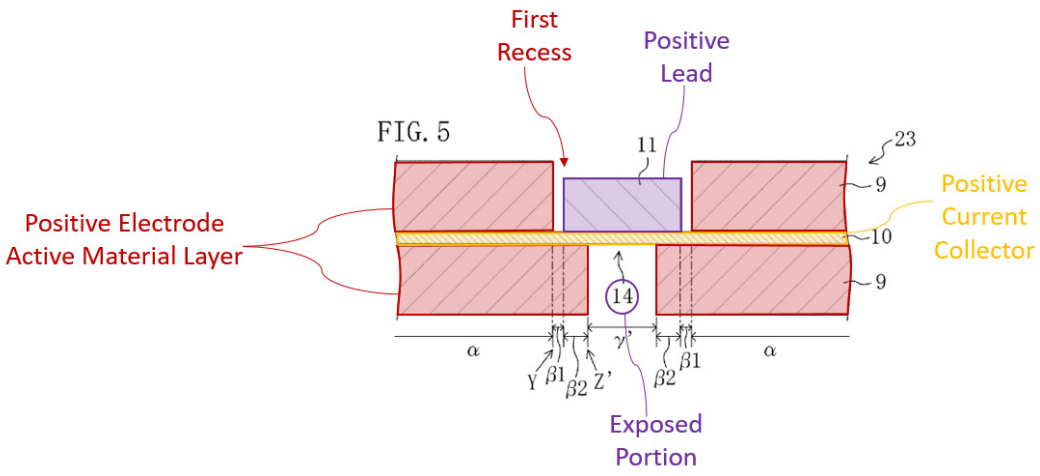
120. Sato discloses that the positive active material layer (4B/9) is provided

with a first recess (exposed portion 12/14) accommodating a positive lead (lead 11) coupled with the positive current collector (4A/10). EX1005, ¶¶[0039], [0041], [0111]-[0113], FIGs. 3, 5.[4] Both sides of Sato's positive current collector (4A/10) are coated with the positive active material layer (4B/9). EX1005, ¶¶[0039], [0041], [0111]-[0113], FIGs. 3, 5.




EX1005, FIG. 3 (annotated).

[4] A POSA would have understood that Sato's extension lead 11 shown in Figures 3 and 5 is representative of a positive lead and a negative lead. EX1005, ¶93 ("A lead is connected in order to take current and Voltage from the positive electrode plate 4 and the negative electrode plate 5. In this connection, a portion of the current collector to which the lead is attached needs to be exposed beforehand.")




EX1005, FIG. 5 (annotated).

121. In particular, Sato describes making the battery cell by peeling away the positive active material layer (4B/9) from the surface of the positive electrode current collector (4A/10) to create the exposed portion 12/14 in the form of a recess in the positive active material layer (4B/9), and attaching the positive electrode lead 11 within the recess by ultrasonic welding. EX1005, ¶¶[0111]-[0113].

122. Accordingly, a POSA would have understood that Sato discloses Element [1.B].

**4. [1.C] a negative electrode comprising a negative current collector and a negative electrode active material layer containing graphite or silicon, wherein the negative electrode active material layer is formed on the negative current collector,**

123. Sato discloses a negative electrode (plate 5) with a negative current collector (5A/10) and a negative electrode active material layer (layer 5B/9)

formed on the negative current collector (5A/10). EX1005, ¶¶[0030], [0034], FIGs. 2, 3, 5; *see also* EX1006, ¶[0003], FIG. 9 (disclosing a negative electrode including a negative current collector 6 and negative electrode active material layer 4). Sato also discloses that the negative active material layer can contain graphite or silicon. EX1005, ¶[0066].

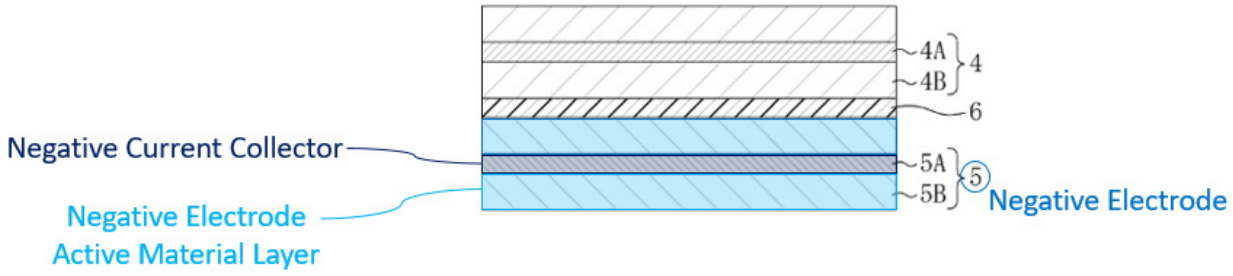



FIG. 3

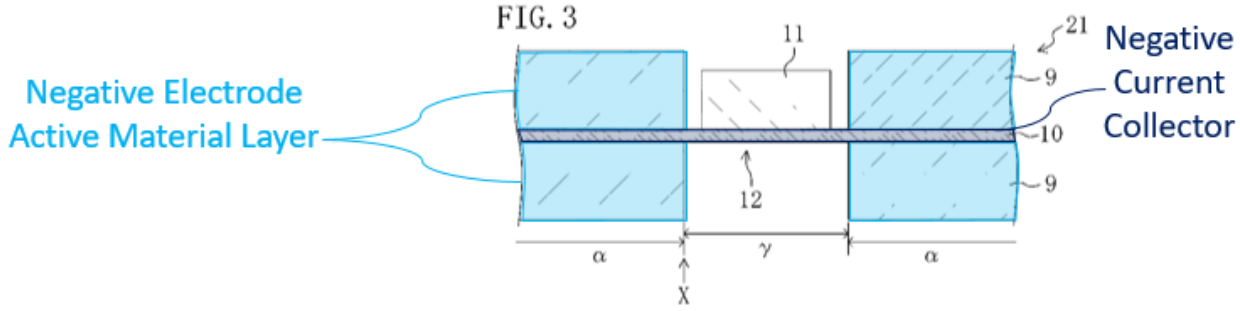
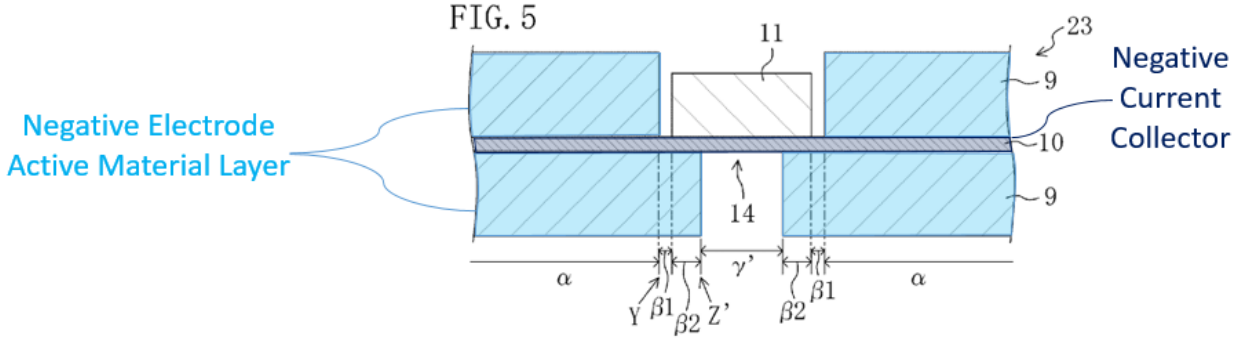



FIG. 5



EX1005, FIGs. 2, 3, 5 (annotated).

124. Again, when assembled, Sato's battery includes a positive electrode plate 4, a negative electrode plate 5, and a separator 6 made of, for example, polyethylene. EX1005, ¶[0030]. The positive electrode plate 4 and the negative electrode plate 5 are wound in a spiral with the separator 6 interposed between them. EX1005, ¶[0030].

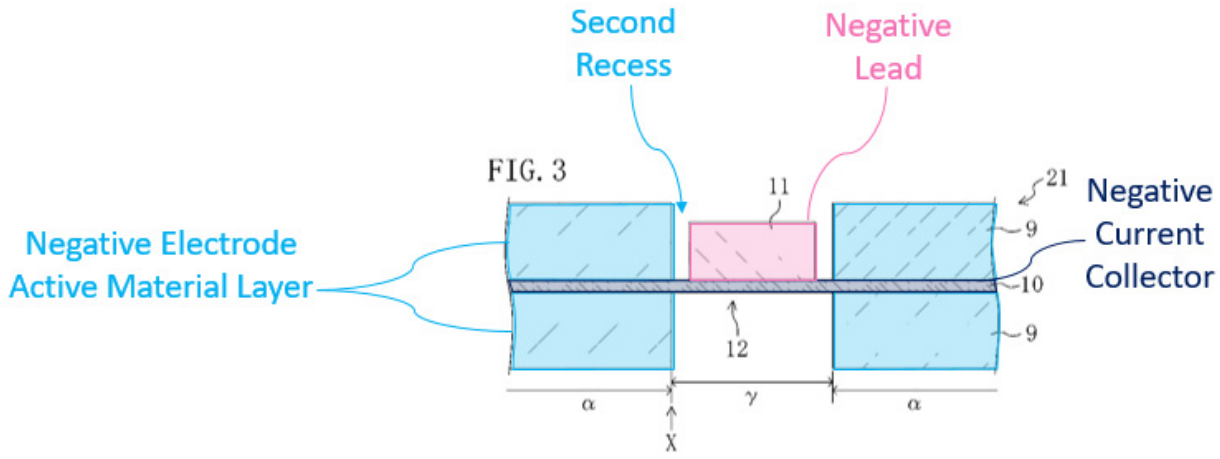
125. As illustrated in Figure 2 and explained by Sato, "the negative electrode plate 5 includes a negative electrode current collector 5A and a negative electrode material mixture layer 5B." EX1005, ¶[0034]. Sato's negative electrode current collector 5A "is in the shape of a band, and is a conductive foil member." EX1005, ¶[0034]. Sato's negative electrode current collector 5A is formed from "stainless steel, nickel, or copper." EX1005, ¶62. Sato's negative electrode material mixture layer 5B is "provided on each surface of the negative electrode current collector 5A, and contains a negative electrode active material." EX1005, ¶[0034]. Sato's negative electrode material mixture layer 5B is formed from a "metal, metal fiber, a carbon material, oxide, nitride, a silicon compound, a tin compound, and various alloys." EX1005, ¶[0066]. Sato's carbon material includes "various natural graphites" and "various artificial graphites." EX1005, ¶[0066]. Sato's silicon compounds include $SiO_x$ and a silicon alloy. EX1005, ¶[0067]. A POSA would have understood that Sato's negative electrode 5 corresponds to the

recited "negative electrode" because Sato's carbon/silicon compound material mixture layer 4B is a common negative electrode active material that allows for efficient lithium ion intercalation and deintercalation during charging and discharging. EX1023, 199.

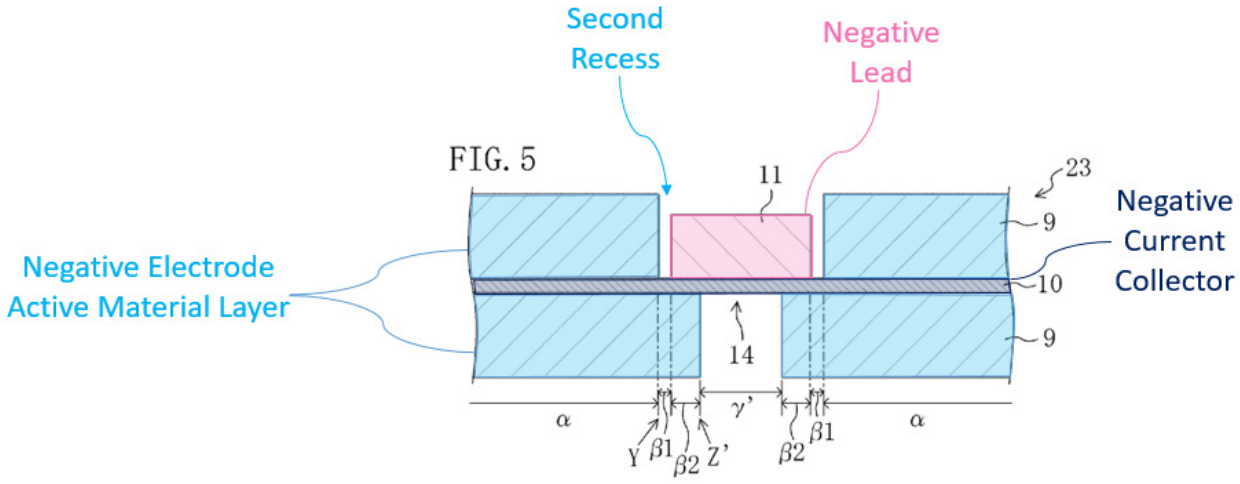
126. Accordingly, a POSA would have understood that Sato discloses Element [1.C].

**5. [1.D] the negative electrode active material layer being provided with a second recess accommodating a negative lead being coupled with the negative current collector;**

127. Sato discloses that the negative electrode active material layer (5B/9) is provided with a second recess (exposed portion 12/14) accommodating a negative lead (lead 11) coupled with the negative current collector (5A/10). EX1005, ¶¶[0039], [0041], [0136], [0137], FIGs. 3, 5. Both sides of Sato's negative current collector (5A/10) are coated with the negative active material layer (5B/9). EX1005, ¶¶[0039], [0041], [0136], [0137], FIGs. 3, 5.



EX1005, FIG. 3 (annotated).




EX1005, FIG. 5 (annotated).

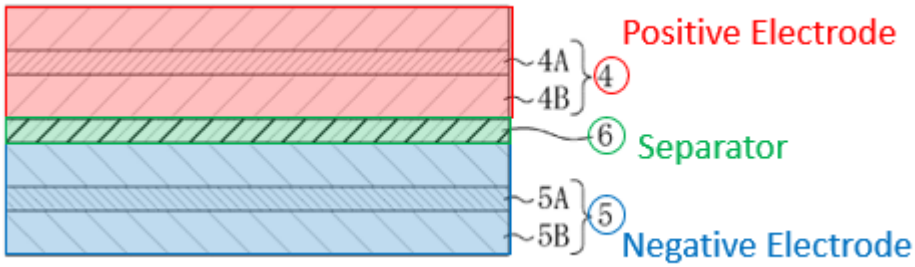
128. In particular, Sato describes making the battery cell by peeling away the negative active material layer (4B/9) from the surface of the negative electrode current collector to create the exposed portion 12/14 in the form of a recess in the negative active material layer (4B/9), and attaching the negative lead 11 within the recess. EX1005, ¶¶[0111]-[0113], and [0136]-[0137].

129. Accordingly, a POSA would have understood that Sato discloses Element [1.D].

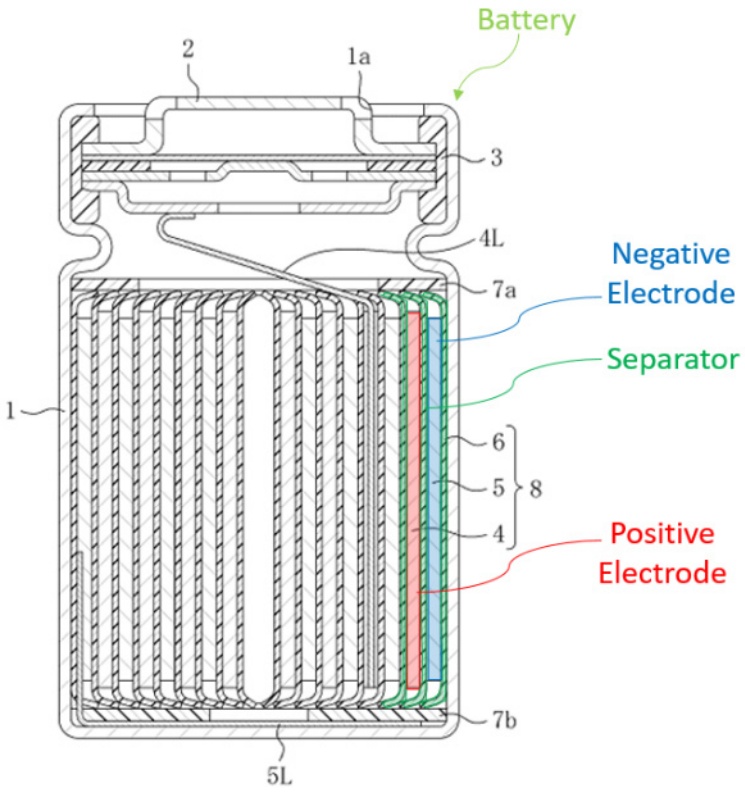
### 6. [1.E] a separator disposed between the positive electrode and the negative electrode; and

130. Sato discloses a separator 6 disposed between the positive electrode (plate 4) and the negative electrode (plate 5). EX1005, ¶[0030], [0035], [0044], [0071], FIG. 2. "The positive electrode plate 4 and the negative electrode plate 5 are wound [in] a spiral with the separator 6 interposed therebetween." EX1005,

¶[0030]; *see also* EX1006, ¶[0003], FIG. 8 (disclosing a separator disposed between and wound with the positive electrode and the negative electrode)




EX1005, FIG. 2 (annotated).




EX1005, FIG. 1 (annotated).

131. Accordingly, a POSA would have understood that Sato discloses Element [1.E].

**7. [1.F] an electrolyte,**

132. Sato discloses an electrolyte, for example, a liquid nonaqueous electrolyte, a gelled nonaqueous electrolyte, or a solid nonaqueous electrolyte. EX1005, ¶¶[0028], [0044], and [0074]; *see also* EX1006, ¶[0003]; (disclosing a non-aqueous electrolyte).

133. Accordingly, a POSA would have understood that Sato discloses Element [1.F].

**8. [1.G] wherein, a top surface of the positive lead is provided with a first insulating glue layer,**

134. Sato discloses that "the leads were protected and insulated by a polypropylene adhesive tape with a width of 8 mm in the positive electrode plate and by a polyethylene adhesive tape in the negative electrode plate." EX1005, ¶[0113].

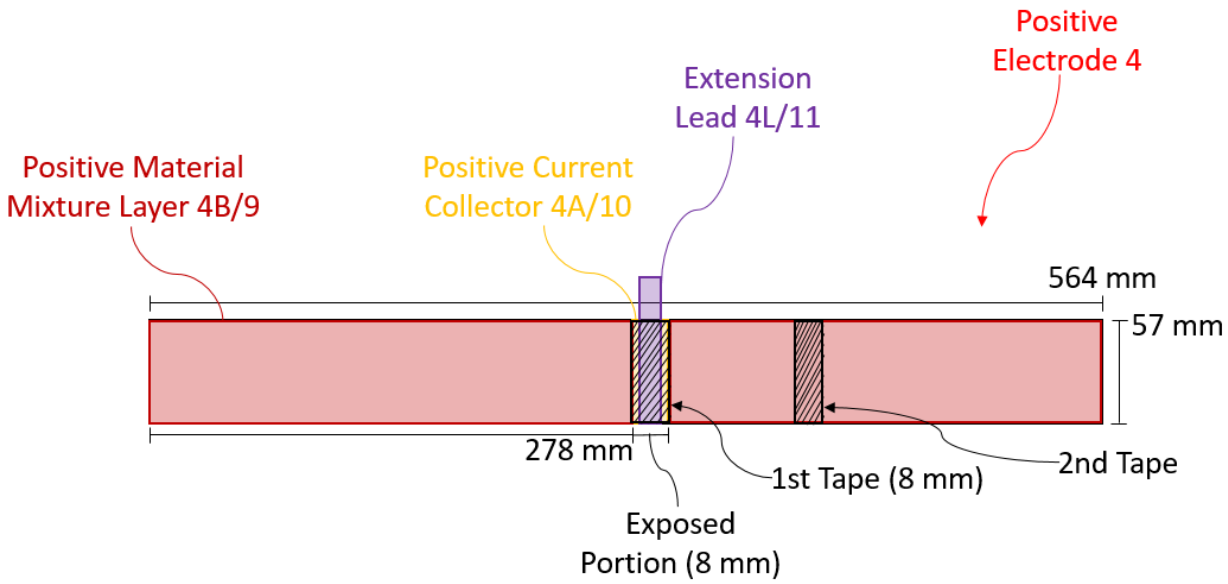
135. A POSA would have understood that Sato's polypropylene adhesive tape is provided to the top surface of the positive lead 11 within the exposed portion 12. The bottom surface of Sato's positive lead 11 was welded to the positive electrode plate 4, leaving the top surface exposed within the recessed exposed portion 12. EX1005, ¶[0112]. That exposed top surface is the surface protected and insulated by Sato's polypropylene adhesive tape.

136. As an example, the following annotated figures show Sato's positive electrode plate according to Battery 1 and negative electrode plate according to

Battery 8 with dimensions as described in Sato. Sato's positive electrode has "a width of 57 mm" and "a length of 564 mm." EX1005, ¶[0104].[5] A portion of positive electrode material mixture layer 4B/9 is "peeled off from the surface of the positive electrode current collector" to expose a portion of the positive electrode current collector 4A/10 "from the position of 278 mm to the position of 286 mm in the length direction" of positive electrode 4. EX1005, ¶[0111]. Sato's positive electrode lead 4L/11 is "attached to the lead connection surface from which the mixture layer of the positive electrode current collector had been peeled off." EX1005, ¶[0112]. Because Sato's electrode lead has "a width of 6 mm," 2 mm of the exposed positive current collector surface remains exposed. EX1005, ¶[0112]. Sato's exposed positive current collector and lead is "protected and insulated" by applying a polypropylene adhesive tape (labeled "1st tape") having a width of 8 mm to the exposed portion of the positive electrode plate, as shown below. EX1005, ¶[0113]. It is my understanding that Patent Owner equates adhesive tape

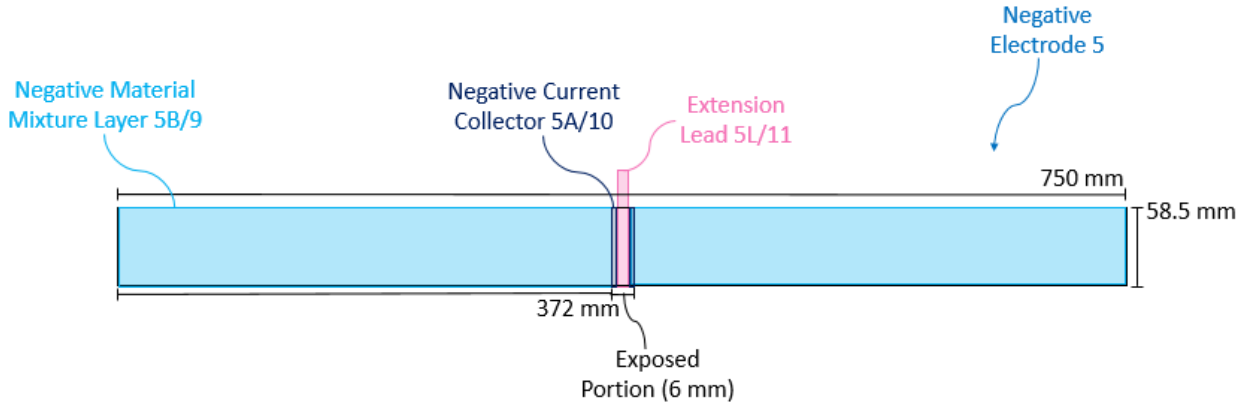
[5] Sato's Battery 8 includes a positive electrode and negative electrode made in the same manner as described in Battery 1 except for the placement of the tabs. *See* EX1005, ¶¶[0136] ("A positive electrode plate was formed in the same manner as in Example 1."); [0137] ("[A] battery 8 was fabricated in the same manner as the battery 1.")

to an insulating glue layer in the related district court complaint. EX1024, 8, 27, 28. Under Patent Owner's position, Sato's polypropylene adhesive tape is an insulating glue layer. Furthermore, a POSA would have understood that Sato's polypropylene adhesive tape is located on top of the positive lead 4L/11 to "protect[] and insulate[]" all the exposed portions of positive lead 4L/11 from the negative electrode, as shown below.




Sato's Positive Electrode.[6]

[6] A POSA would have understood that Sato's 2nd tapes would be located on both sides of the positive electrode so as to face the negative lead connection. *See* EX1005, ¶137. The exact positioning of the 2nd tape in the longitudinal direction of Sato's position electrode plate would depend on the location of the second recess




Sato's Negative Electrode.

137. Accordingly, a POSA would have understood that Sato discloses Element [1.G].

**9. [1.H] a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer,**

**a. Sato**

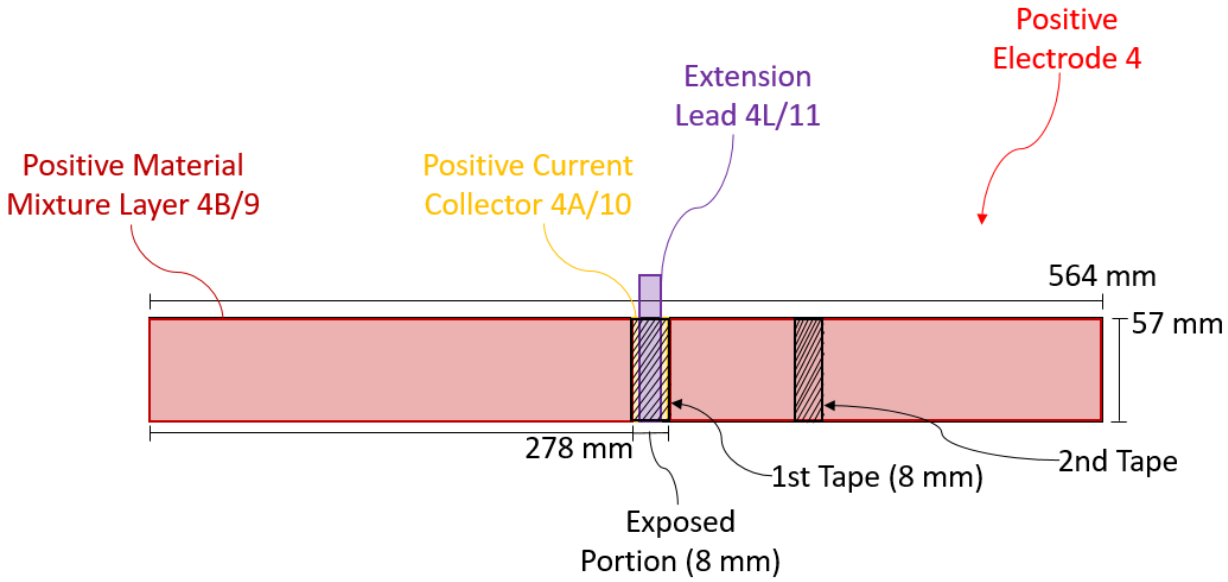
138. Sato discloses that "the positive electrode surface facing the negative electrode lead position was insulated by a polypropylene adhesive tape in order to prevent lithium deposition." EX1005, ¶[0137]. I understand that under Patent Owner's position in the related district court complaint, Sato's additional

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formed in Sato's negative electrode plate. The 2nd tape is shown in this drawing to indicate where the 1st and 2nd tapes could be located relative to each other on one side of Sato's positive electrode.

polypropylene adhesive tape is a second insulating glue layer. EX1024, 8, 27, 28.

139. This additional polypropylene adhesive tape in Sato covers a portion of the positive electrode active layer (4B/9) to isolate that portion from the negative electrode. EX1005, ¶[0148]. A POSA would have understood that the position of Sato's additional layer of polypropylene adhesive tape (labeled "2nd tape") would depend on how the two electrodes were aligned at the initiation of the spiral winding and that it would be preferable to offset the two tabs so they did not interfere with one another.




Sato's Positive Electrode.

140. Although Sato discloses placing the additional polypropylene adhesive tape in the vicinity of the negative lead to prevent lithium deposition, Sato does not explicitly disclose or illustrate that the additional polypropylene adhesive tape is located at "a surface of the positive electrode active material layer

opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate." However, a POSA would have understood that Sato's additional polypropylene adhesive tape is located on Sato's positive electrode active material (4B/9) in a position that overlaps the exposed foil 12/14 (recess) where Sato's negative lead 11 is located to avoid lithium plating.

141. Lithium plating is likely at any location where positive active material is located opposite exposed metal on the negative electrode on the other side of the separator. EX1019, 1317; EX1020, 379; EX1021, 242; EX1023, 201. Accordingly, a POSA would have known that the only logical place to locate Sato's additional polypropylene adhesive tape on the positive active material would have been opposite to the recess in the negative active material across the separator. This location would have been opposite to exposed metal in the recess formed in the negative active material, where the negative lead is attached, which is most susceptible to plating of lithium ions released from the positive electrode active material during the battery's charging cycle. A POSA would have been concerned that the presence of this exposed metal would result in lithium plating because it was known that exposed metal opposite positive active material was susceptible to lithium plating during the battery's charging cycle. For example, Takemura knew that exposed metal on the negative electrode was susceptible to lithium plating. EX1006, ¶[0008]; *see also* EX1009, ¶¶[0002], .

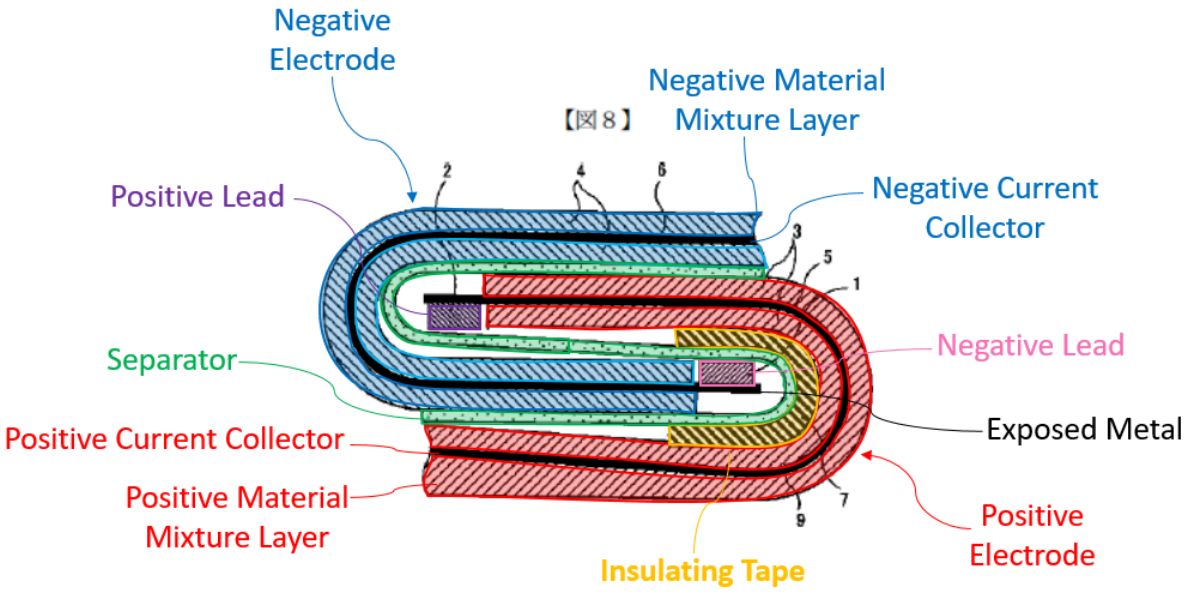
142. Applying Sato's additional polypropylene adhesive tape on the positive active material at any location other than opposite to the recess in the negative active material across the separator would likely have had no effect on potential lithium plating. Again, lithium plating occurs at exposed metal opposite positive active material. A POSA would have understood that insulating positive active material at locations not opposite from exposed metal on the negative electrode would have had little to no effect on lithium plating at the exposed metal. Further, a POSA would have understood that randomly placed tape would reduce capacity of the battery to no benefit.

**b. Takemura**

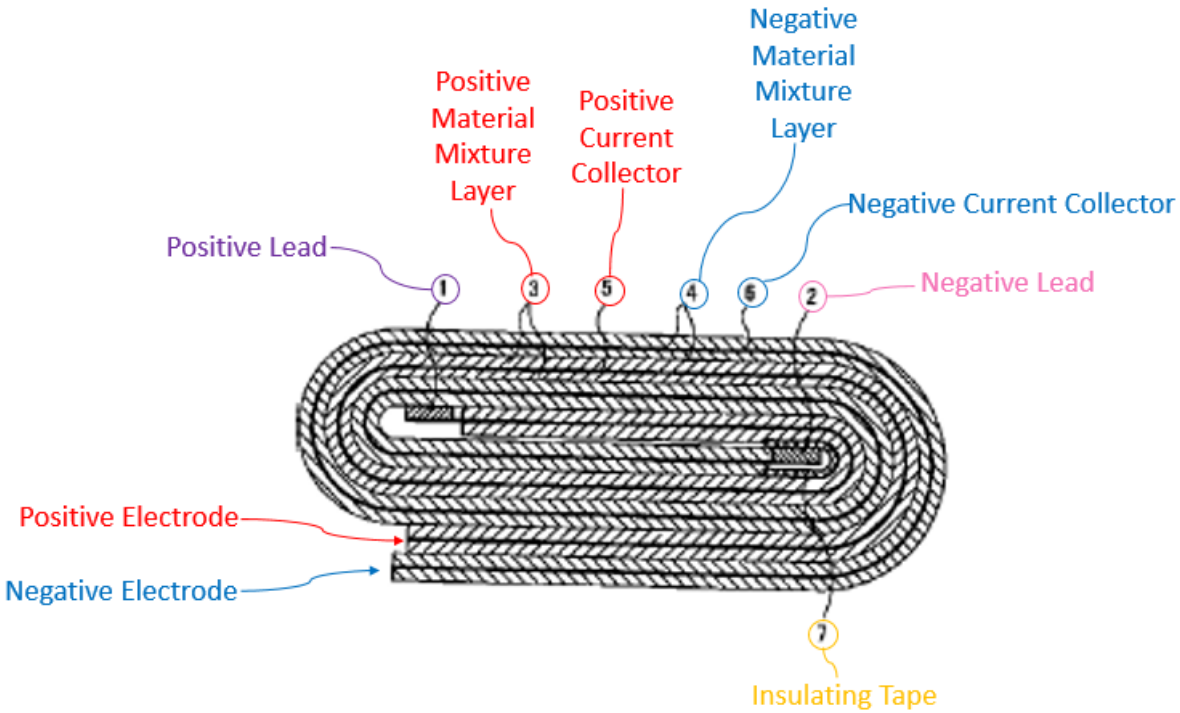
143. To the extent Sato does not explicitly disclose attaching the additional tape on the positive active material "opposite to the second recess across the separator in a thickness direction of the positive plate," Takemura discloses that such positioning would have been obvious.

144. Takemura discloses a coiled lithium-ion battery with an insulating tape 7 located on the positive active material layer 3 across a separator 8 opposite to a negative lead 2 and configured to prevent lithium plating around the negative lead 2. EX1006, ¶[0003] FIGs. 8, 9. For example, Takemura's Figures 8 and 9 (reproduced below), disclose a coiled lithium-ion battery cell with the insulating tape 7 attached to the positive active material layer 3 adjacent to the separator 8

and across from exposed metal portions on the negative electrode current collector 6 where the negative lead 2 is attached.




EX1006, FIG. 8 (annotated).



EX1006, FIG. 9 (annotated).

**c. Combination of Sato and Takemura**

145. In view of Sato's and Takemura's disclosures, it would have been obvious to a POSA to apply Sato's additional polypropylene adhesive tape to "a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate." Positioning the additional tape at this location would prevent lithium plating by overlapping exposed metal on Sato's negative current collector (5A/10).

146. Both Sato and Takemura disclose that insulating the positive active material opposite to exposed metal on the negative electrode prevents lithium plating. EX1005, ¶[0137]; EX1006, ¶[0008]. Sato's additional insulating tape is applied to the positive active material "facing the negative electrode lead position" where the negative foil was exposed. EX1005, ¶[0137]. Takemura's insulating tape 7 is applied to the positive active material facing exposed metal on both surfaces of the negative current collector 6. EX1006, ¶[0008], FIGs. 8, 9.

147. Positioning Sato's additional polypropylene adhesive tape on the positive electrode active material layer 4B/9 opposite to the second recess (exposed portion 12/14 on the negative positive current collector 4A/10) across the separator 6 would prevent lithium plating by isolating the positive electrode active material layer 4B/9 from the exposed metal in the second recess. Given Sato's and

Takemura's disclosures, this is the only logical place a POSA would have applied Sato's additional polypropylene adhesive tape toprevent lithium plating. Positioning Sato's additional polypropylene adhesive tape in this manner would have simply been applying a known technique (placing Takemura's tape at a known position) within Sato's similar battery, for a predictable result of preventing lithium plating as identified by both Sato and Takemura.

148. Accordingly, a POSA would have understood that the combined disclosures of Sato and Takemura render Element [1.H] obvious.

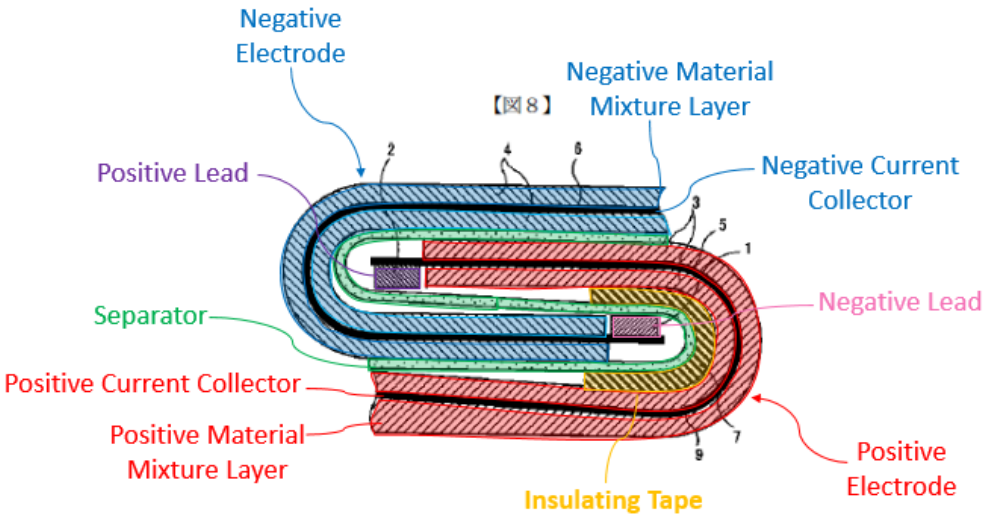
**10. [1.I] the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of the second recess.**

**a. Sato**

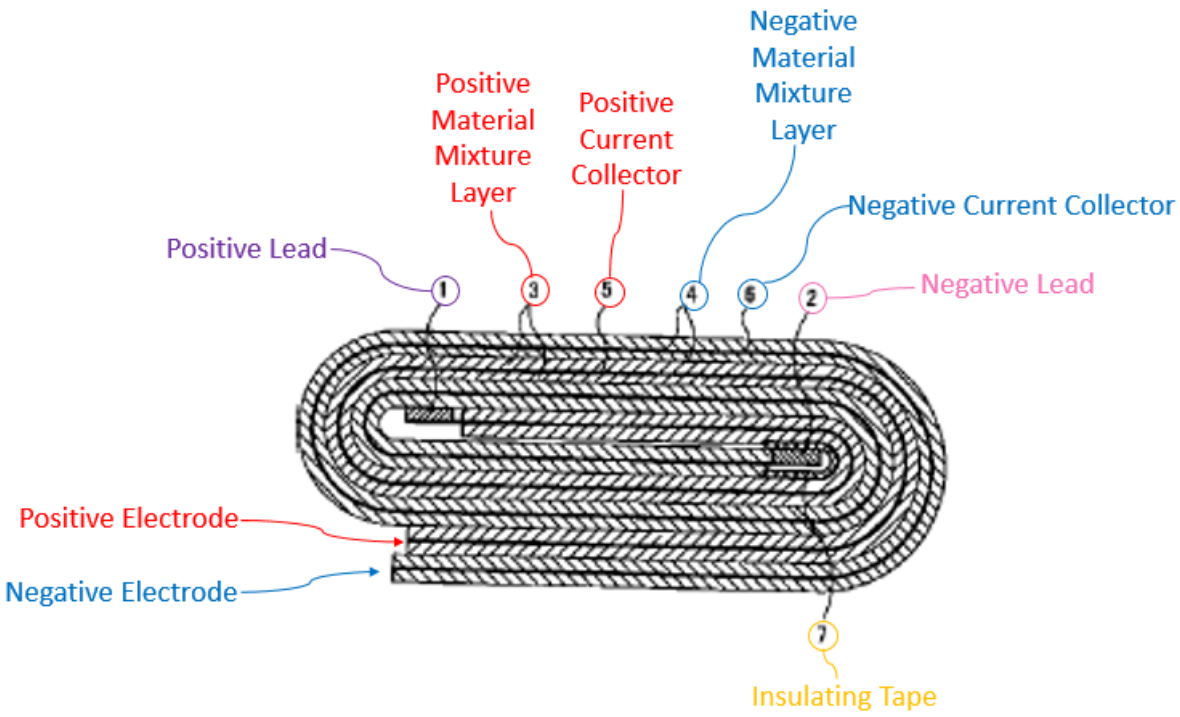
149. Sato discloses that "the positive electrode surface facing the negative electrode lead position was insulated by a polypropylene adhesive tape in order to prevent lithium deposition." EX1005, ¶[0137]. Although Sato discloses placing the additional polypropylene adhesive tape in the vicinity of the negative lead to prevent lithium plating, Sato is silent about the additional polypropylene adhesive tape having a width larger than a width of the second recess and a length larger than a length of the second recess. However sizing an insulating tape to overlap the entirety of a recess and extend over portions surrounding all four sides of the recess was well known, as evidenced by Takemura.

**b. Takemura**

150. Takemura discloses placing an insulating tape 7 on the positive electrode active material layer 3 adjacent to a negative electrode current collecting lead 2 and exposed metal portions of the negative current collector 6. EX1006, ¶[0003], FIG. 9. As illustrated in both Takemura's Figure 8 and Figure 9, the insulating tape 7 is sized such that it overlaps (i) *all* the exposed metal on the negative current collector 6 and (ii) the edge of the negative active material 4 above and below the negative lead 2. Notably, both Figures 8 and 9 show that Takemura's tape 7 extends beyond the exposed negative electrode current collector 6 and over the negative electrode active material 4. Takemura sized the tape 7 in this manner to ensure that all exposed metal on the negative current collector 6 is isolated to prevent lithium plating. EX1006, ¶[0008].




EX1006, FIG. 8 (annotated).




EX1006, FIG. 9 (annotated).

151. Thus, Takemura explicitly discloses that the insulating tape 7 has a width (measured along the length of the negative electrode in the cross-section shown in Figures 8 and 9) larger than the exposed metal on the negative electrode current collector 6.

152. Although Takemura does not explicitly disclose that the insulating tape 7 has a length larger than the length of the exposed metal on the negative electrode current collector 6, a POSA would have understood that Takemura's tape 7 had a length larger than the length of the exposed metal on the negative electrode current collector 6. Again, to avoid lithium plating, *all* exposed metal on the negative electrode opposite positive active material should be isolated. EX1022, 51

(illustrating that exposed metal on the negative electrode located opposite to positive electrode active material is susceptible to lithium plating). Sizing Takemura's tape 7 to have a length less than or equal to the length of the exposed metal would only have invited lithium plating in Takemura's battery, which would have been directly contrary to the reason for having the tape 7 in the first place. What is more, sizing Takemura's tape 7 to have a length larger than the length of the exposed metal would have helped ensure that metal on the negative electrode current collector 6 is not exposed as result of alignment variances. EX1022, 51 (explaining that "an underlap condition [i.e., exposed metal on the negative electrode] may occur in some region of a cell, if dimensional and alignment tolerances are not adequately managed").

**c. Combination of Sato and Takemura**

153. In view of Sato's and Takemura's disclosures, it would have been obvious to a POSA to apply Sato's additional polypropylene adhesive tape such that it had a width and length larger than the width and length of the exposed portion 12/14 (second recess) formed in Sato's negative electrode active material layer 5B/9 accommodating the negative lead 11. This sizing would have ensured that all exposed metal in the exposed portion 12/14 was properly isolated from positive active material to avoid lithium plating.

154. Sizing Sato's additional polypropylene adhesive tape to have a width

and/or length less than or equal to the width and/or length of the exposed portion 12/14 would only have invited lithium plating in Sato's battery, which would have been directly contrary to Sato's reason for adding this additional tape in the first place. Sizing Sato's additional polypropylene adhesive tape to have a width and length larger than the width and length of the exposed metal in the exposed portion 12/14 would also have been necessary to ensure that metal in the exposed portion 12/14 is not exposed to lithium plating as a result of alignment variances. For at least these reasons, having a larger width and length for Sato's additional polypropylene adhesive tape would have amounted to nothing more than sizing the additional tape according to known principles for a known benefit identified by both Sato and Takemura. Moreover, changing the size of Sato's second insulating tape to be wider and longer than the recess would not lead to any unexpected results.

155. Accordingly, a POSA would have understood that the combined disclosures of Sato and Takemura render Element [1.I] obvious.

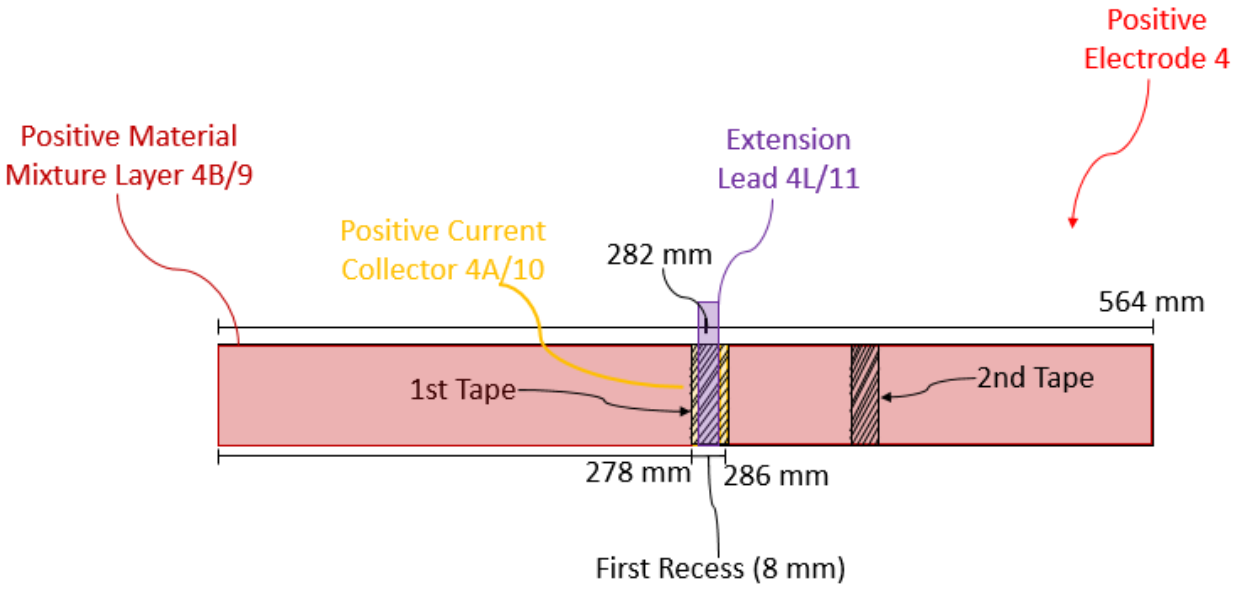
**11. 2. The lithium-ion battery of claim 1, wherein a distance between a center of the first recess and one end of the positive electrode active material layer is ¼-¾ of a length of the positive electrode active material layer; and a distance between a center of the second recess and one end of the negative electrode active material layer is ¼-¾ of a length of the negative electrode active material layer.**

156. Sato discloses that a distance between a center of the first recess

(exposed portion 12/14 where the positive lead 11 is attached to the plate 4) and one end of the positive electrode active material layer (layer 4B/9) is ¼-¾ of a length of the positive electrode active material layer (layer 4B/9). EX1005, ¶¶[0111]-[0113]. Similarly, Sato discloses that a distance between a center of the second recess (exposed portion 12/14 where the negative lead 11 is attached to the plate 5) and one end of the negative electrode active material layer (layer 5B/9) is ¼-¾ of a length of the negative electrode active material layer (layer 5B/9). EX1005, ¶[0137] According to Sato, the center of the exposed portion 12/14 is located at ½ the length of the active layers in the electrodes of Sato's Batteries 1 and 8 described in paragraphs [0111]-[0113], [0136], and [0137].

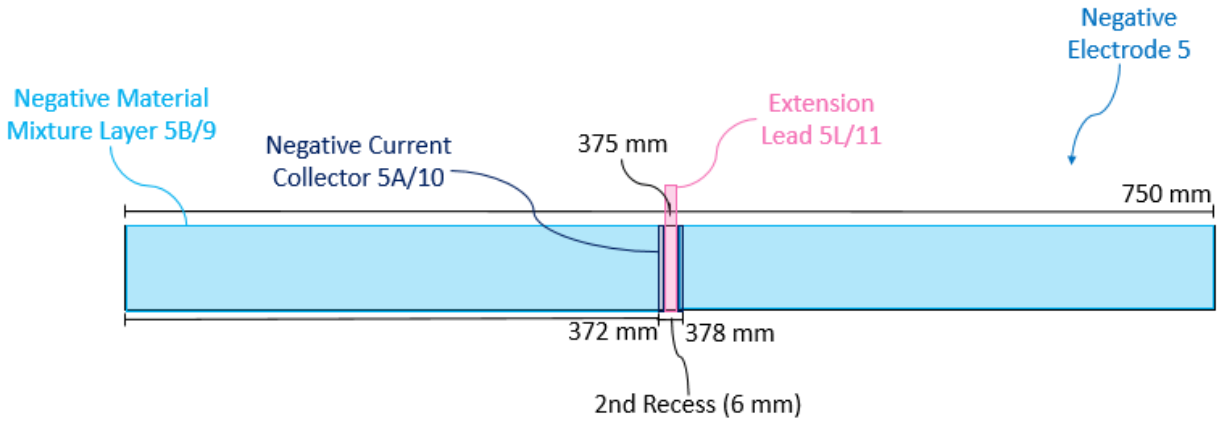
157. The dimensions of the positive and negative electrodes in Sato's Battery 1 and Battery 8 are illustrated in the following annotated figures. A POSA would have understood that the positive electrode active material layer begins at the ends of the electrode plate in view of Sato's positive electrode manufacturing process. EX1005, ¶[0104]. Specifically, Sato describes applying a positive electrode material mixture slurry to both surfaces of an aluminum foil to form a positive electrode plate and then cutting through the positive electrode plate to provide the positive electrode at its desired length. EX1005, ¶[0104]. In doing so, Sato cuts through both the positive current collector and the positive active material layer such that the positive active material layer extends to the edges of

the positive electrode plate.




Sato, Positive Electrode.

158. As shown above, Sato's positive electrode plate has "a length of 564 mm." EX1005, ¶[0104]. And the exposed portion of Sato's positive current collector connected to the positive lead is located "from the position of 278 mm to the position of 286 mm in the length direction" of positive electrode 4. EX1005, ¶[0111]. Accordingly, the distance from the center of Sato's first recess to the end of the positive active material layer is 282 mm, which corresponds to 50% ( $\frac{282\ mm}{564\ mm}$ ) of the length of Sato's positive electrode.




Sato, Negative Electrode.

159. As shown above, Sato's negative electrode plate has "a length of 750 mm." EX1005, ¶[0107]. A POSA would have understood that the negative electrode active material begins at the ends of the electrode plate in view of Sato's negative electrode manufacturing process. EX1005, ¶[0137]. Specifically, Sato describes applying a negative electrode material mixture slurry to both surfaces of a copper foil to form a negative electrode plate and then cutting through the negative electrode plate to provide the negative electrode at its desired length. EX1005, ¶[0107]. In doing so, Sato cuts through both the negative current collector and the negative active material layer such that the negative active material layer extends to the edges of the negative electrode plate. The exposed portion of Sato's negative current collector connected to the negative lead is located "from the position of 372 mm to the position of 378 mm relative to an end of the negative plate in the length direction." EX1005, ¶[0137]. Accordingly, the distance from the

center of Sato's second recess to the end of the negative active material layer is 375 mm, which corresponds to 50% ( $\frac{375\ mm}{750\ mm}$ ) of the length of Sato's negative electrode.

160. Thus, a POSA would have understood that Sato discloses claim 2.

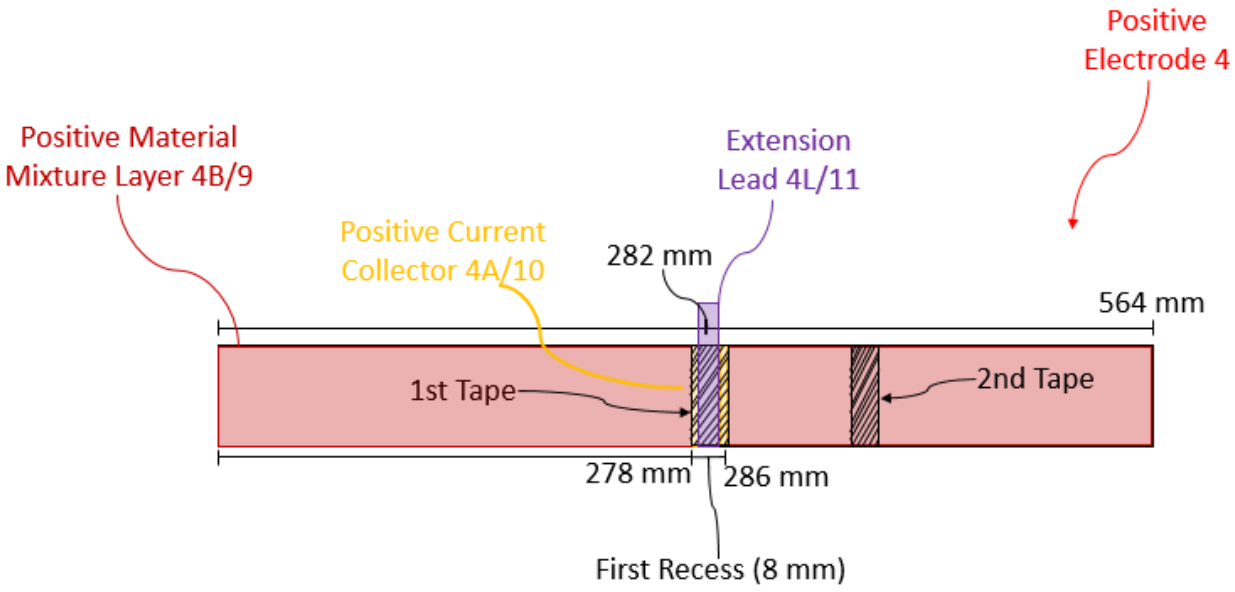
161. In addition to the specific location of the lead attachments for the positive and negative electrodes in Battery 1 and Battery 8, Sato describes that the "attachment position" of the lead "is preferably located in the range from ¼ to ¾" of the length of the electrode plate to achieve "sufficient current collection" and to effectively utilize the battery's "internal volume." EX1005, ¶[0094] ("Suppose in the length direction of the electrode plate, the start point is 0 (zero), the end point is 1 (one), and 0 (zero) is the start end of winding of the electrode group, this lead attachment position is preferably located in the range from ¼ to ¾."). Accordingly, arranging the location of Sato's positive lead attachment to be within 1/4 to 3/4 of a length of the positive electrode active material layer and Sato's negative lead attachment to be within 1/4 to 3/4 of a length of the negative electrode active material layer would have been obvious to promote efficient current collection.

**12. 3. The lithium-ion battery of claim 2, wherein, the distance between the center of the first recess and the one end of the positive electrode active material layer is half of the length of the positive electrode active material layer; and the distance between the center of the second recess and the one**

**end of the negative electrode active material layer is half of the length of the negative electrode active material layer.**

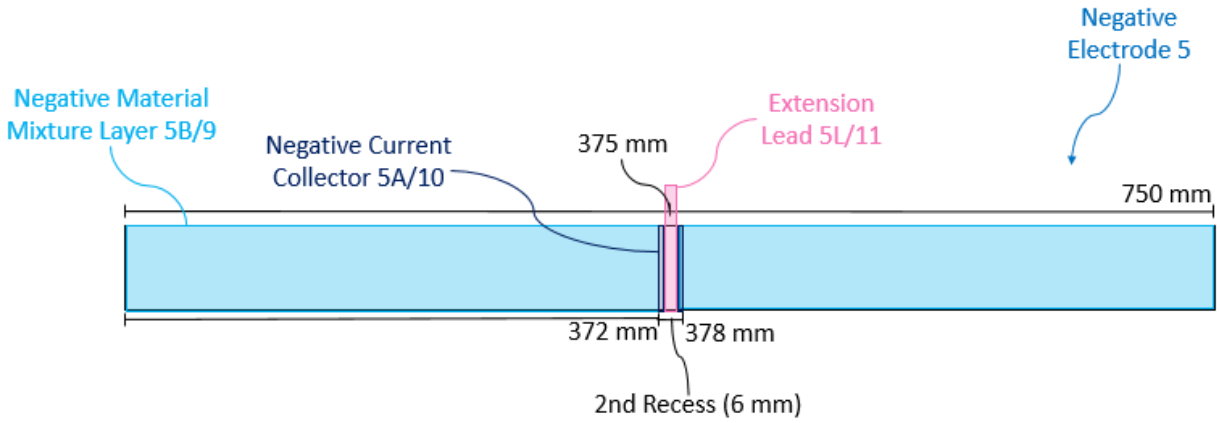
162. Sato discloses that a distance between a center of the first recess (exposed portion 12/14 where the positive lead 11 is attached to the plate 4) and one end of the positive electrode active material layer (layer 4B/9) is half of a length of the positive electrode active material layer (layer 4B/9). EX1005, ¶¶[0111]-[0113]. Similarly, Sato discloses that a distance between a center of the second recess (exposed portion 12/14 where the negative lead 11 is attached to the plate 5) and one end of the negative electrode active material layer (layer 5B/9) is half of a length of the negative electrode active material layer (layer 5B/9). EX1005, ¶[0137]. According to Sato, the center of the exposed portion 12/14 is located at ½ the length of the active layers in the positive and negative electrodes in Sato's Battery 1 and Battery 8 described in paragraphs [0111]-[0113], [0136], and [0137].

163. The dimensions of the positive and negative electrodes in Sato's Battery 1 and Battery 8 are illustrated in the following annotated figures.




Sato, Positive Electrode.

164. As shown above, Sato's positive electrode plate has "a length of 564 mm." EX1005, ¶[0104]. And the exposed portion of Sato's positive current collector connected to the positive lead is located "from the position of 278 mm to the position of 286 mm in the length direction" of positive electrode 4. EX1005, ¶[0111]. Accordingly, the distance from the center of Sato's first recess to the end of the positive active material layer is 282 mm, which corresponds to 50% ( $\frac{282\ mm}{564\ mm}$ ) of the length of Sato's positive electrode.




Sato, Negative Electrode.

165. As shown above, Sato's negative electrode plate has "a length of 750 mm." EX1005, ¶[0107]. And the exposed portion of Sato's negative current collector connected to the negative lead is located "from the position of 372 mm to the position of 378 mm relative to an end of the negative plate in the length direction." EX1005, ¶[0137]. Accordingly, the distance from the center of Sato's second recess to the end of the negative active material layer is 375 mm, which corresponds to 50% ( $\frac{375\ mm}{750\ mm}$ ) of the length of Sato's negative electrode.

166. Thus, a POSA would have understood that Sato discloses claim 3.

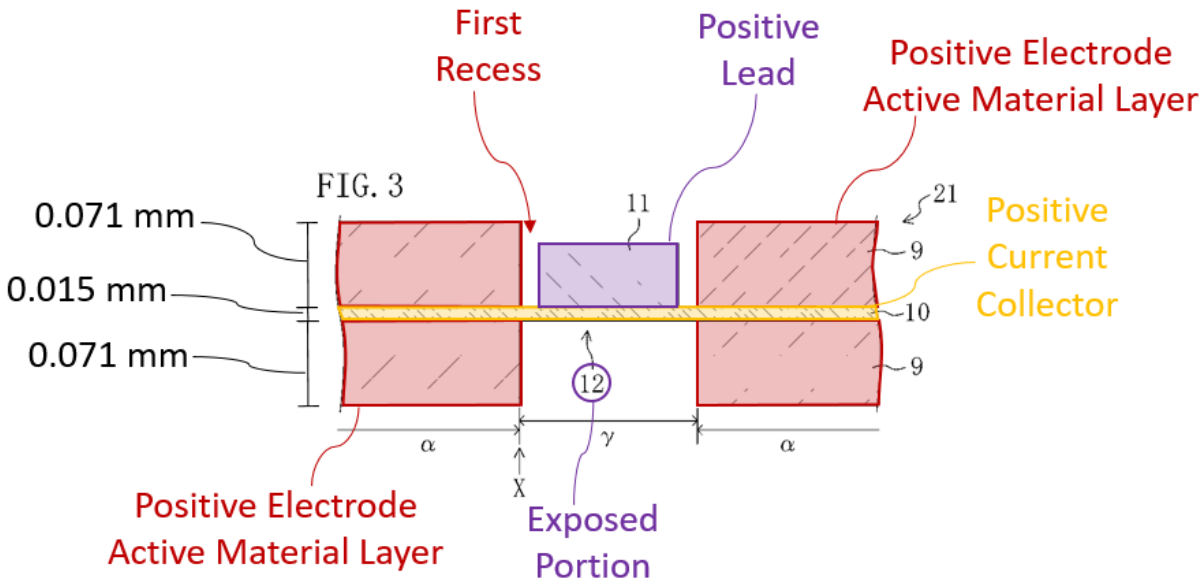
167. In addition to the specific location of the lead attachments for the electrodes in Battery 1 and Battery 8, Sato describes that the "attachment position" of the lead "is preferably located in the range from ¼ to ¾" of the length of the electrode plate to achieve "sufficient current collection" and effectively utilize the battery's "internal volume." EX1005, ¶[0094] ("Suppose in the length direction of

the electrode plate, the start point is 0 (zero), the end point is 1 (one), and 0 (zero) is the start end of winding of the electrode group, this lead attachment position is preferably located in the range from ¼ to ¾."). Accordingly, arranging the location of Sato's positive lead attachment to be half of a length of the positive electrode active material layer and Sato's negative lead attachment to be half of a length of the negative electrode active material layer would have been obvious to promote efficient current collection.

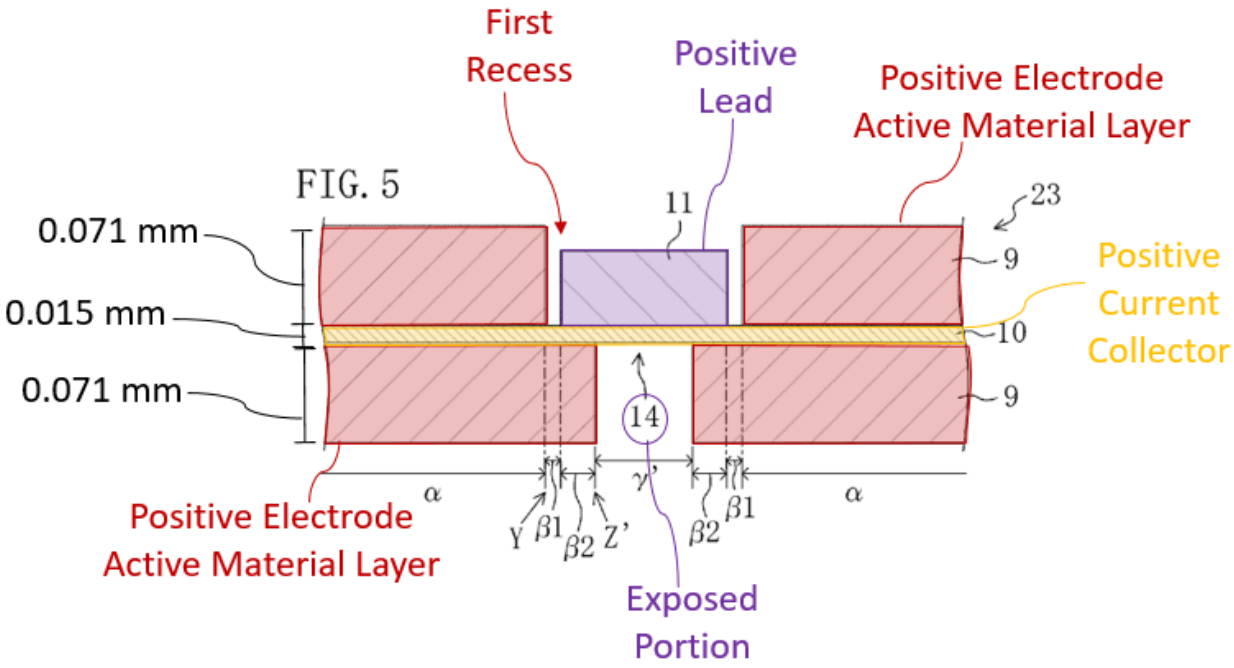
**13. 6. The lithium-ion battery of claim 1, wherein the first recess has a depth of 0.005-0.1 mm larger than a thickness of the positive lead, and the second recess has a depth of 0.005-0.1 mm larger than a thickness of the negative lead.**

168. For one example battery (Battery 1), Sato discloses "a positive electrode plate having a thickness of 0.157 mm" (i.e., a thickness of 157 μm). EX1005, ¶[0104]. Sato's positive electrode plate includes an aluminum foil current collector "with a thickness of 15 μm." EX1005, ¶[0104]. A POSA would have understood that the thickness of each positive electrode active material layer applied on the surface of the positive current collector is 0.071 mm ($\frac{0.157\ mm - 0.015\ \mu m}{2}$). A POSA would have further understood that the depth of Sato's exposed portion corresponds to the thickness of the active material layer. Sato further describes connecting a "positive electrode lead (with a width of 6 mm)" to the exposed portion (i.e., the first recess) of Sato's positive electrode. EX1005, ¶[0112]. In view of Figures 3 and 5, reproduced below, a POSA would

have understood that Sato's first recess (annotated) has a depth of 0.005-0.071 mm larger than the thickness of positive lead (11).

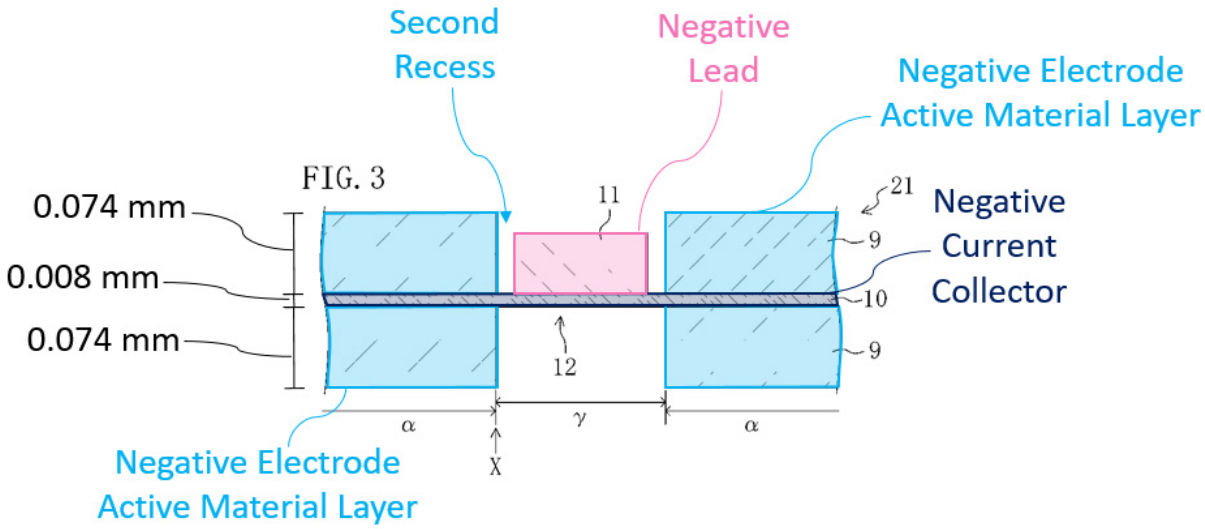



EX1005, FIG. 3 (annotated).

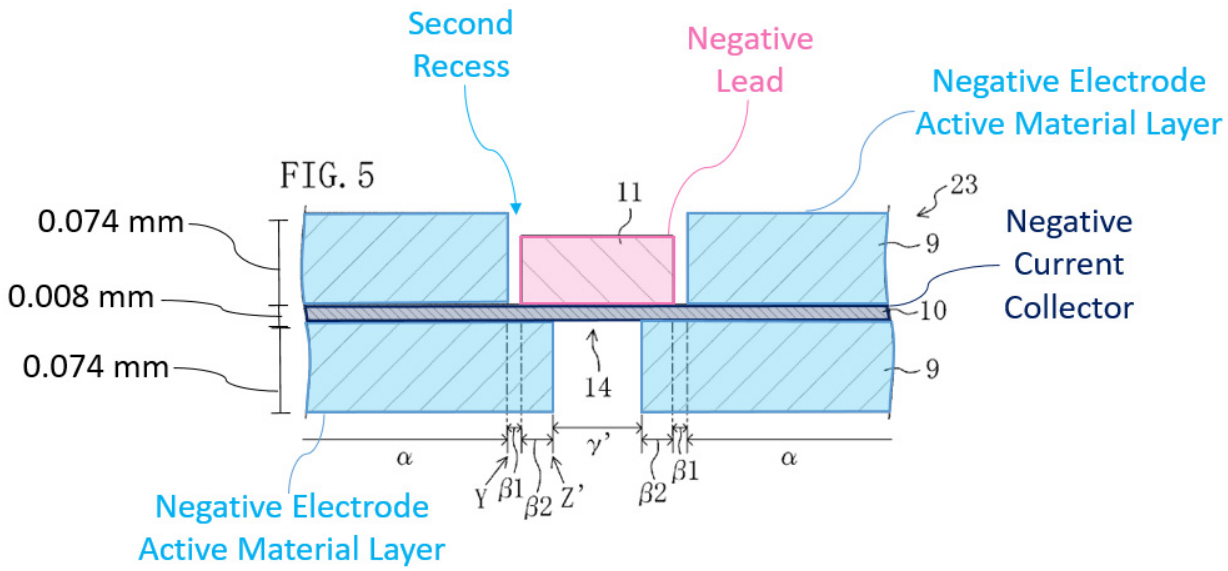



EX1005, FIG. 5 (annotated).

169. Similarly, for Battery 8, Sato discloses a negative electrode plate having "a thickness of 0.156 mm" (i.e., a thickness of 156 µm). EX1005, ¶[0107]. Sato's negative electrode plate includes an aluminum foil current collector "with a thickness of 8 µm." EX1005, ¶[0107]. A POSA would have understood that the thickness of each negative electrode active material layer applied on the surface of the negative current collector is 0.074 mm ($\frac{0.156\ mm - 0.008\ mm}{2}$). A POSA would have further understood that the depth of Sato's exposed portion corresponds to the thickness of the active material layer. Sato further describes connecting a "negative electrode lead (with a width of 4 mm)" to the exposed portion (i.e., the second recess) of Sato's negative electrode. EX1005, ¶[0112]. In view of Figures 3 and 5, reproduced below, a POSA would have understood that Sato's second recess (annotated) has a depth of 0.005-0.074 mm larger than the thickness of negative lead (11).



EX1005, FIG. 3 (annotated).



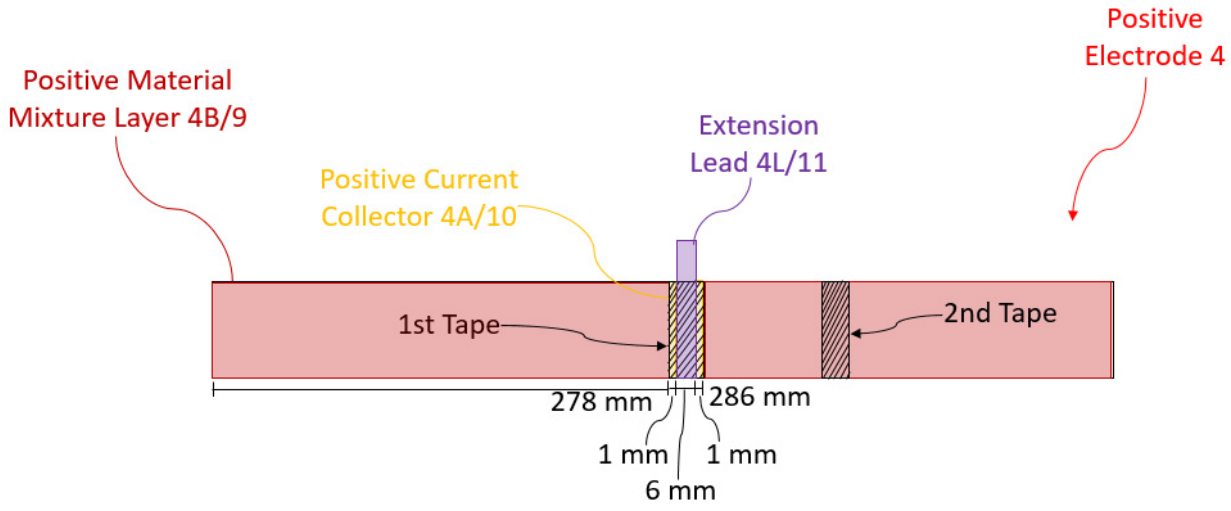

EX1005, FIG. 5 (annotated).

170. Furthermore, simply changing the thickness of Sato's lead to fit within the recess would not lead to any unexpected results. A POSA would have also understood that there would have been a finite number of predictable solutions for connecting a lead to an electrode plate. Specifically, a POSA would have understood that there would have been three predictable solutions: (1) making the thickness of the lead greater than the depth of the recess, (2) making the thickness of the lead equal to the depth of the recess, and (3) making the thickness of the lead less than the depth of the recess. All three of these solutions would have been well within the level of ordinary skill in the art, leading to the predictable result of connecting the lead to the electrode plate. A POSA would also have understood that using a lead as thick or thicker than the recess depth could produce an

undesirable bulge in the battery cell winding, which would not be an efficient use of space and would reduce cell capacity. Accordingly, it would have been obvious to use a lead thickness 0.005-0.1 mm less than the depth of Sato's recesses.

**14. 8. The lithium-ion battery of claim 1, wherein a width of a portion of the positive lead in the first recess is greater than a width of a remaining portion of the first recess not occupied by the positive lead located on one side of the positive lead.**

171. Sato discloses a width of a portion of the positive lead in the first recess (exposed portion 12/14) is greater than a width of a remaining portion of the first recess (exposed portion 12/14) not occupied by the positive lead located on one side of the positive lead. As shown below in the annotated figure for the positive electrode of Sato's Battery 1, the width of Sato's positive lead is 6 mm and the width of the remaining exposed portion on each side of the positive lead is 1 mm.



Sato, Positive Electrode

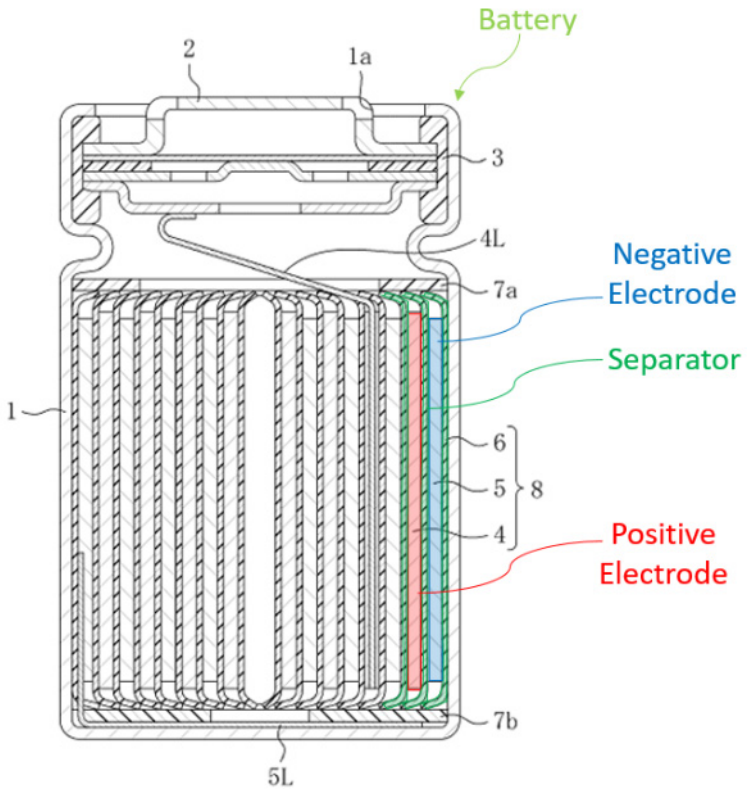
172. Specifically, Sato discloses that the exposed portion in positive electrode 4 has "a width of 8 mm" and that the positive electrode lead has "a width of 6 mm." EX1005, ¶¶[0111]-[0112]. Accordingly, the remaining portion of Sato's first recess located on one side of the positive lead is 1 mm ( $\frac{8\,mm-6mm}{2}$ ), which is less than the 6 mm width of Sato's positive electrode lead.

173. Thus, a POSA would have understood that Sato discloses claim 8.

**15. [17.P] A lithium-ion battery, comprising:**

174. For the same reasons discussed above with respect to Element [1.P], Sato discloses a lithium-ion battery. *See supra* Section IX.D.1; EX1005, ¶[0027], FIG. 1. As I discussed above in Section IX.D.1, Sato discloses that (i) the positive electrode (for example, the positive electrode of Battery 1) can have a recess for accommodating a positive lead, (ii) the negative electrode (for example, the negative electrode of Battery 8) can have a recess for accommodating the negative lead, or (iii) both the positive electrode and the negative electrode can have a recess for accommodating the positive lead and the negative lead, respectively. EX1005, ¶[0094] (explaining that both leads 4 and 5 can be attached to the electrodes at a location ranging from ¼ to ¾ the length of the electrode). Accordingly, POSA would have understood that Sato discloses a lithium-ion battery. And more specifically, a POSA would have understood that Sato discloses

a lithium-ion battery with positive and negative electrodes each having a recess for accommodating the respective lead.

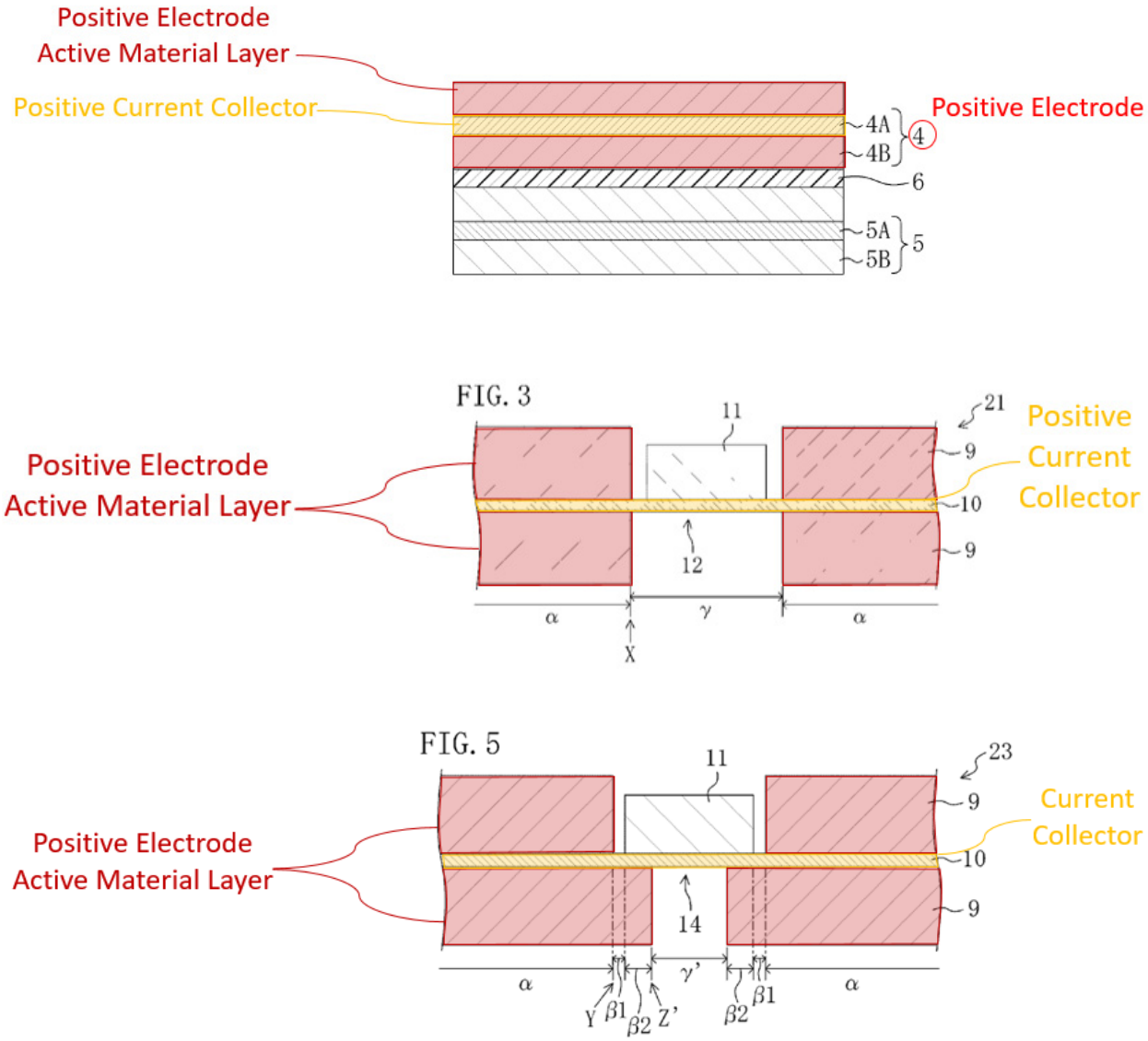



EX1005, FIG. 1 (annotated).

**16. [17.A] a positive electrode, comprising a positive current collector and a positive electrode active material layer being formed on the positive current collector,**

175. For the same reasons discussed above with respect to Element [1.A], Sato discloses the recited "positive electrode" in the form of positive electrode plate 4, the recited "positive current collector" in the form of a positive electrode current collector 4A/10, and the recited "positive electrode active material layer" in the form of electrode material mixture layer 4B/9. *See supra* Section IX.D.2;

EX1005, ¶¶[0030], [0033], [0039].

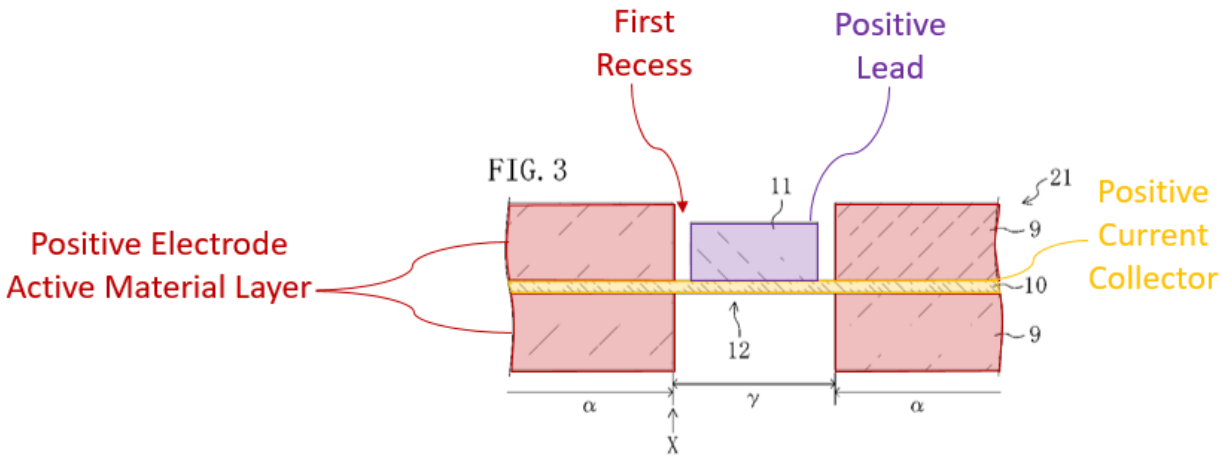



EX1005, FIGs. 2, 3, and 5 (annotated).

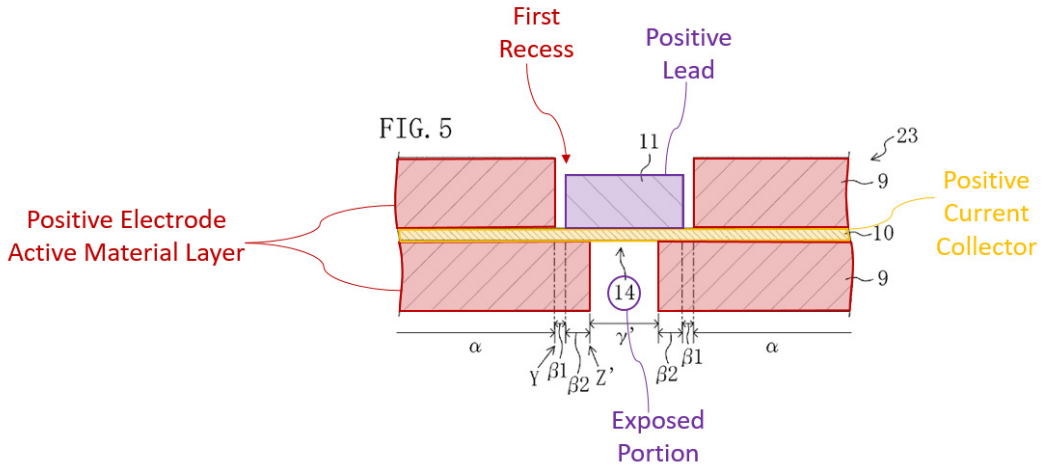
**17. [17.B] the positive electrode active material layer being provided with a first recess accommodating a positive lead being coupled with the positive current collector;**

176. For the same reasons discussed above with respect to Element [1.B], Sato discloses providing the positive active material layer (4B/9) with a first recess

in the form of an exposed portion 12/14 defined where "the mixture layer 9 is not formed on each of both surfaces of the current collector 10." EX1005, ¶¶[0039], 111. Sato discloses coupling a positive lead with the positive current collector in the form of an extension lead 11 "connected to one of the surfaces of the exposed portion 12" of current collector 10. *See supra* Section IX.D.3; EX1005, ¶¶[0039], [0093].




EX1005, FIG. 3 (annotated).




EX1005, FIG. 5 (annotated).

**18. [17.C] a negative electrode, comprising a negative current collector and a negative electrode active material layer being formed on the negative current collector,**

177. For the same reasons discussed above with respect to Element [1.C], Sato discloses the recited "negative electrode" in the form of a negative electrode plate 5, the recited "negative current collector" in the form of a negative electrode current collector 5A/10, and the recited "negative electrode active material layer" in the form of a negative electrode material mixture layer 5B/9. *See supra* Section IX.D.4; EX1005, ¶¶[0034], [0039].

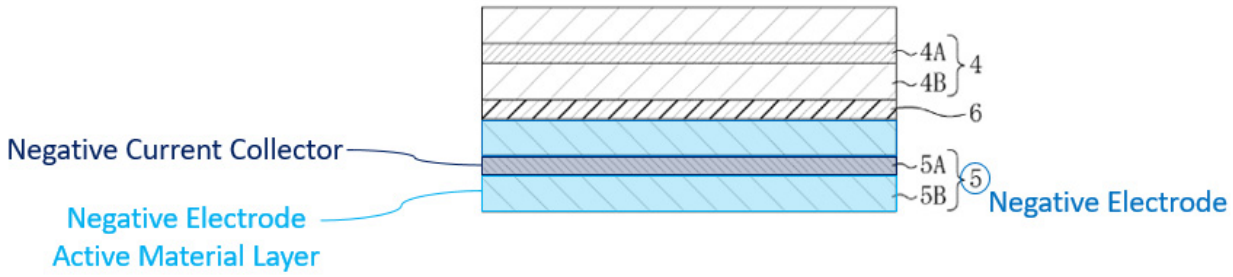
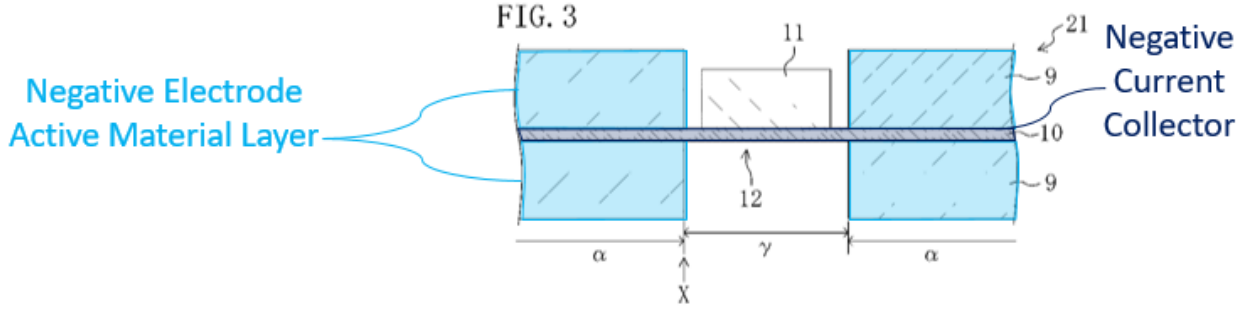
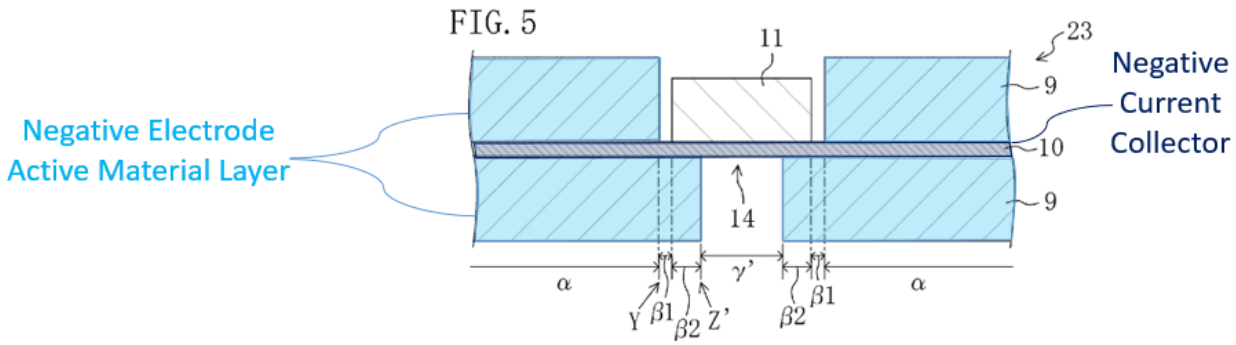



FIG. 3

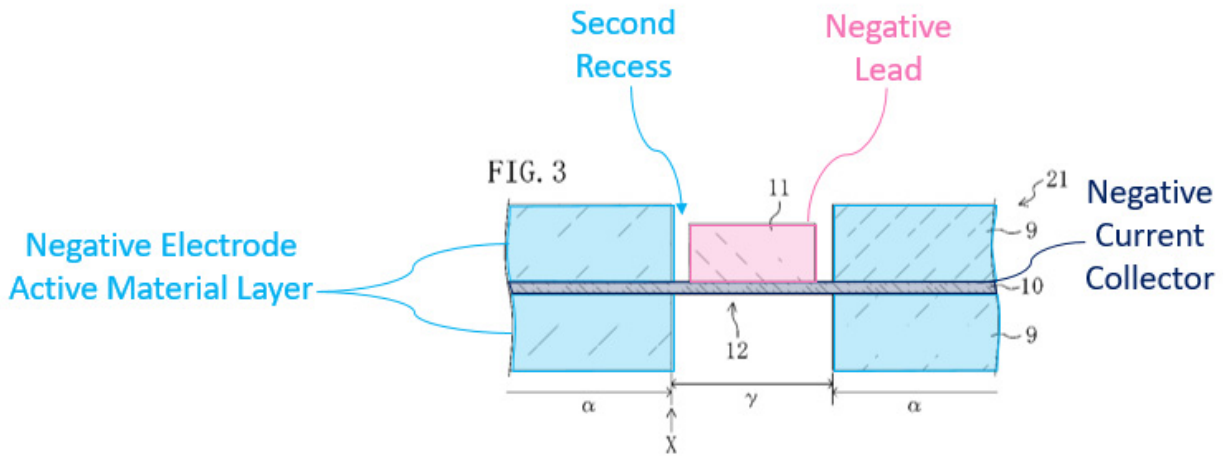




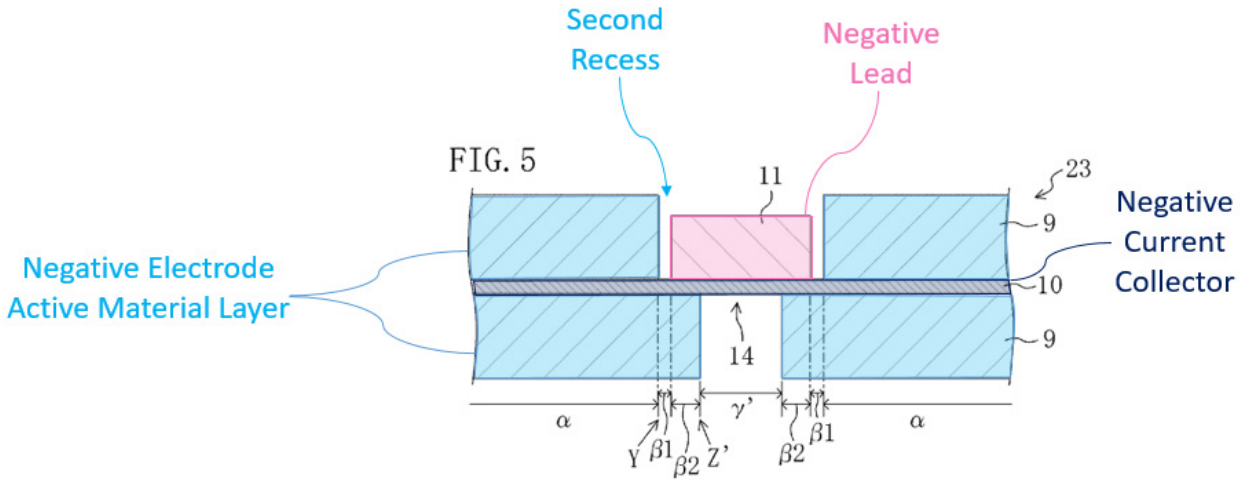

EX1005, FIGs. 2, 3, and 5 (annotated).

**19. [17.D] the negative electrode active material layer being provided with a second recess accommodating a negative lead being coupled with the negative current collector;**

178. For the same reasons discussed above with respect to Element [1.D], Sato discloses providing the negative active material layer (5B/9) with a second recess in the form of an exposed portion 12/14 defined where "the mixture layer 9 is not formed on each of both surfaces of the current collector 10." *See supra* Section IX.D.5; EX1005, ¶¶39, 137. Sato discloses coupling a negative lead with the negative current collector in the form of an extension lead 11 "connected to one of the surfaces of the exposed portion 12" of current collector 10. EX1005, ¶¶39, 93.



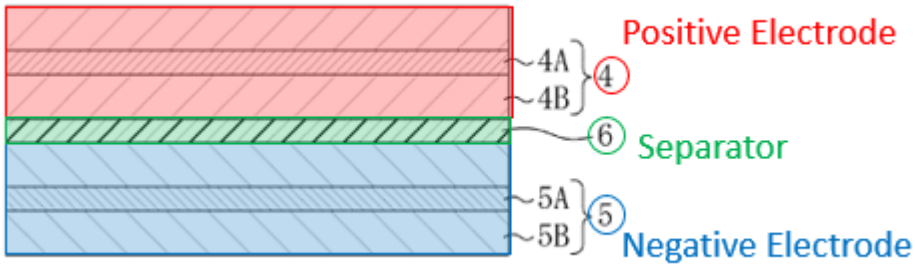

EX1005, FIG. 3 (annotated).



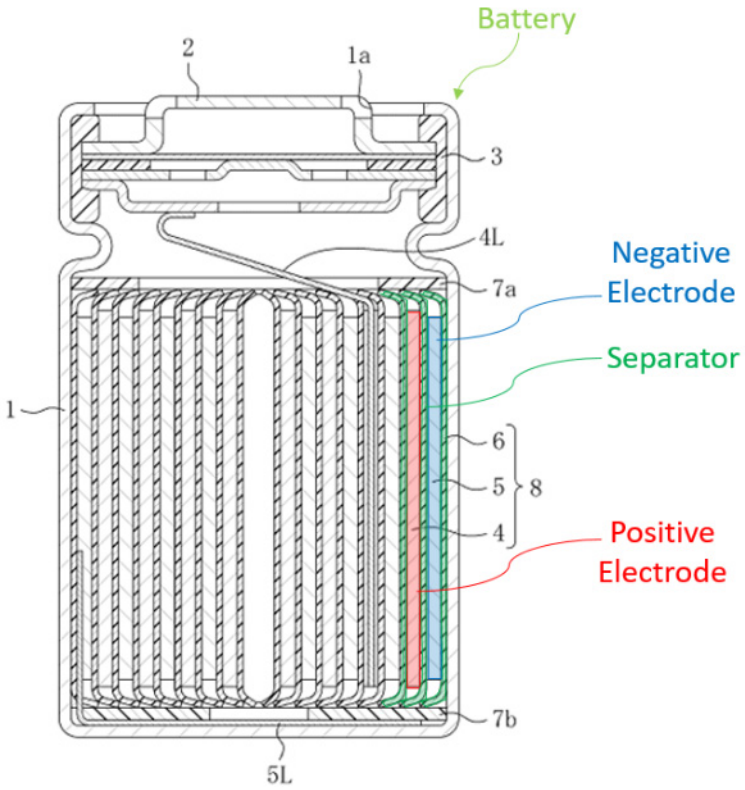

EX1005, FIG. 5 (annotated).

**20. [17.E] a separator disposed between the positive electrode and the negative electrode;**

179. For the same reasons discussed above with respect to Element [1.E], Sato discloses the recited "separator" in the form of "a porous insulating layer (i.e., a separator) 6" interposed between positive electrode plate 4 and negative electrode plate 5. *See supra* Section IX.D.6; EX1005, ¶¶[0030], [0113].




EX1005, FIG. 2 (annotated).




EX1005, FIG. 1 (annotated).

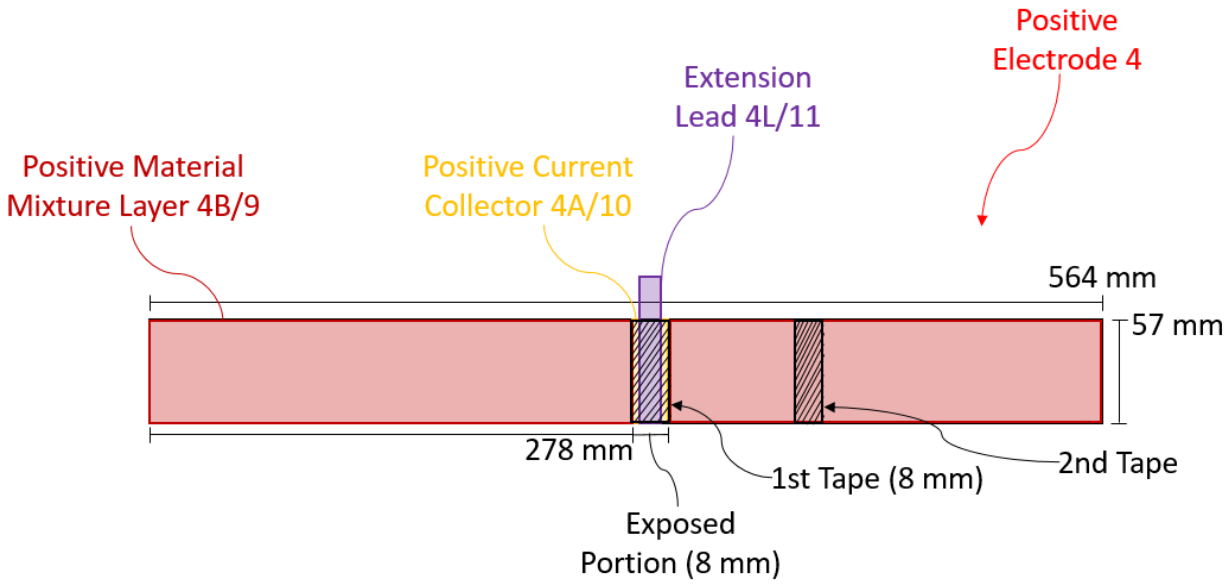
**21. [17.F] "an electrolyte,"**

180. For the same reasons discussed above with respect to Element [1.F], Sato discloses the recited "electrolyte" in the form of a "nonaqueous electrolyte," such as "nonaqueous electrolyte, a gelled nonaqueous electrolyte, or a solid

nonaqueous electrolyte." *See supra* Section IX.D.7; EX1005, ¶¶[0028], [0074].

**22. [17.G] wherein, a first location of a top surface of the positive lead is provided with a first insulating glue layer;**

181. For the same reasons discussed above with respect to Element [1.G], Sato discloses providing a top surface of the positive lead with a polypropylene adhesive tape. *See supra* Section IX.D.8; EX1005, ¶[0113] ("[L]eads…protected and insulated by a polypropylene adhesive tape with a width of 8 mm in the positive electrode plate and by a polyethylene adhesive tape in the negative electrode plate."). It is my understanding that Patent Owner equates adhesive tape to an insulating glue layer in the related district court complaint. EX1024, 8, 27, 28. Under Patent Owner's position, Sato's polypropylene adhesive tape is an insulating glue layer. Furthermore, a POSA would have understood that Sato's polypropylene adhesive tape is located on top of the positive lead 4L/11 to "protect[] and insulate[]" all the exposed portions of positive lead 4L/11 from the negative electrode, as shown below.

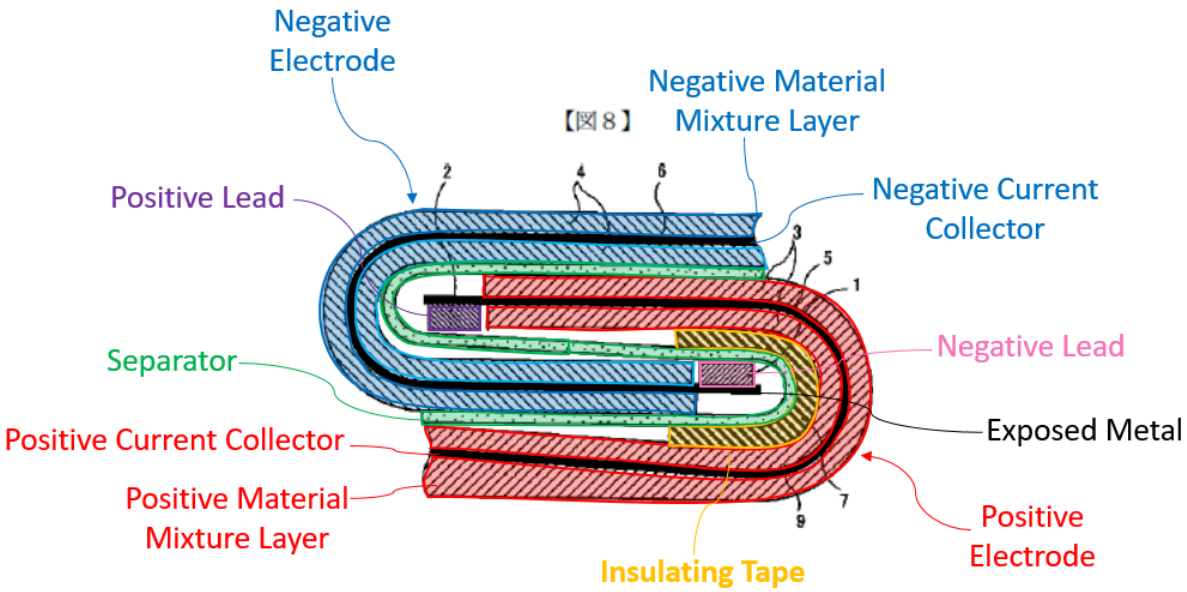



Sato's Positive Electrode.

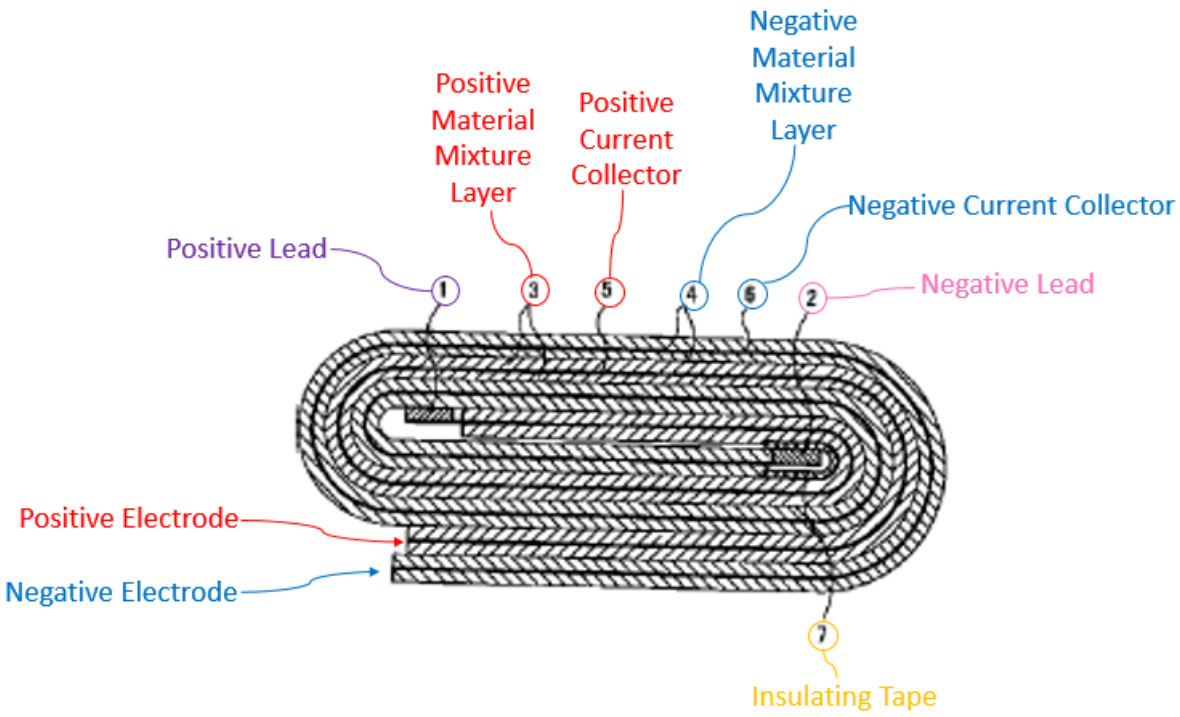
**23. [17.H] a second location of a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer;**

182. For the same reasons discussed above with respect to Element [1.H], the Sato-Takemura combination renders obvious pasting an additional polypropylene adhesive tape at a second location of a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate. *See supra* Section IX.D.9. Specifically, Takemura locates an insulating tape 7 on the positive electrode's active material 3 across a separator 8 opposite a negative lead 2. EX1006, ¶[0003], FIGs. 8-9. In Figures 8-9, reproduced below, Takemura's insulating tape 7 is attached to positive active material 3 adjacent to separator 8 and across from a bare negative electrode

current collector 6 where negative lead 1 is attached. It would have been obvious to apply Sato's additional polypropylene adhesive tape to "a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate," as taught by Takemura, to prevent lightium plating. This modification would have simply been applying a known technique (Takemura's placement of insulating tape) to a known device (Sato's battery) to prevent lithium plating.




EX1006, FIG. 8 (annotated).

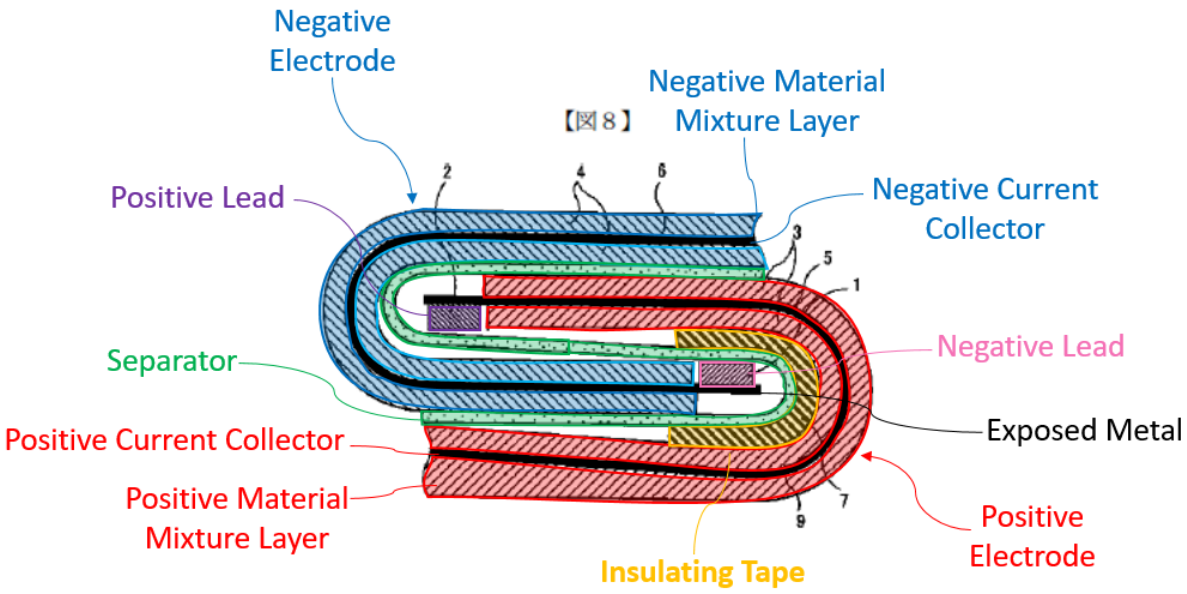



EX1006, FIG. 9 (annotated).

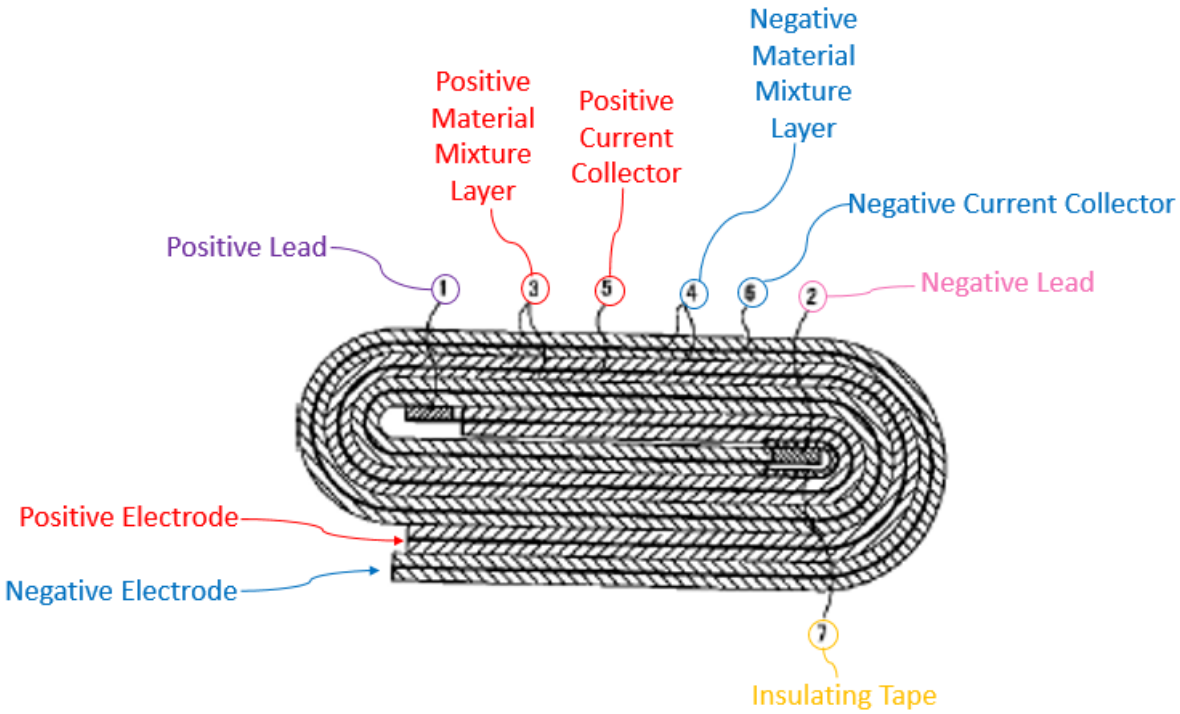
**24. [17.I] the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of the second recess.**

183. For the same reasons discussed above with respect to Element [1.I], the Sato-Takemura combination renders obvious a second insulating tape having a width larger than a width of the second recess and a length larger than a length of the second recess. *See supra* Section IX.D.10. Specifically, in Figures 8-9, Takemura's insulating tape 7 is sized such that it overlaps (i) *all* the exposed metal on the negative current collector 6 and (ii) the edge of the negative active material 4 above and below the negative lead 2, to insulate exposed metal and prevent lithium plating. EX1006, ¶[0008]. Thus, Takemura's insulating tape has a width

(measured along the length of the negative electrode cross-section in Figures 8-9) larger than the exposed metal on the negative electrode current collector. Although Takemura does not illustrate that the insulating tape has a length larger than the length of the exposed metal on the negative electrode current collector, a POSA would have found it obvious to minimize exposing the negative electrode metal to lithium ions released from the positive active material. EX1022, 51. Sizing Sato's additional polypropylene adhesive tape to have a width and length larger than the width and length of the exposed metal in the exposed portion 12/14 would have been necessary to ensure that metal in the exposed portion 12/14 is not exposed to lithium plating as a result of alignment variances. For at least these reasons, having a larger width and length for Sato's additional polypropylene adhesive tape would have amounted to nothing more than sizing the additional tape according to known principles for a known benefit identified by both Sato and Takemura.



EX1006, FIG. 8 (annotated).

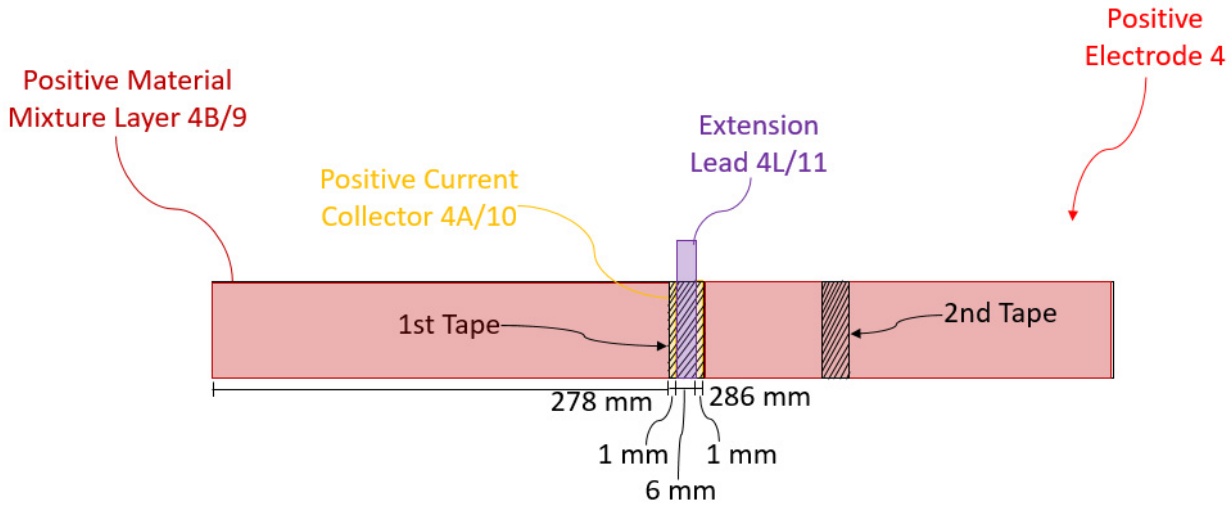



EX1006, FIG. 9 (annotated).

**25. 19. The lithium-ion battery of claim 17, wherein a width of a portion of the first lead in the first recess is greater than a width of a remaining portion of the first recess not occupied by the first lead located on one side of the first lead.**

184. For the same reasons discussed above with respect to claim 8, Sato discloses a width of a portion of the positive lead in the first recess is greater than a width of a remaining portion of the first recess not occupied by the positive lead located on one side of the positive lead in the form of arranging a positive lead having a width of 6 mm in an exposed portion of Sato's positive current collector 4A/10 having a width of 8 mm such that the remaining portion of Sato's exposed portion on one side of the positive lead is 1 mm. *See supra* Section IX.D.14;

EX1005, ¶¶[0111]-[0112]. Specifically, Sato discloses that the exposed portion in positive electrode 4 has "a width of 8 mm" and that the positive electrode lead has "a width of 6 mm." EX1005, ¶¶[0111]-[0112]. Accordingly, the remaining portion of Sato's first recess located on one side of the positive lead is 1 mm ( $\frac{8\,mm-6mm}{2}$ ), which is less than the 6 mm width of Sato's positive electrode lead.



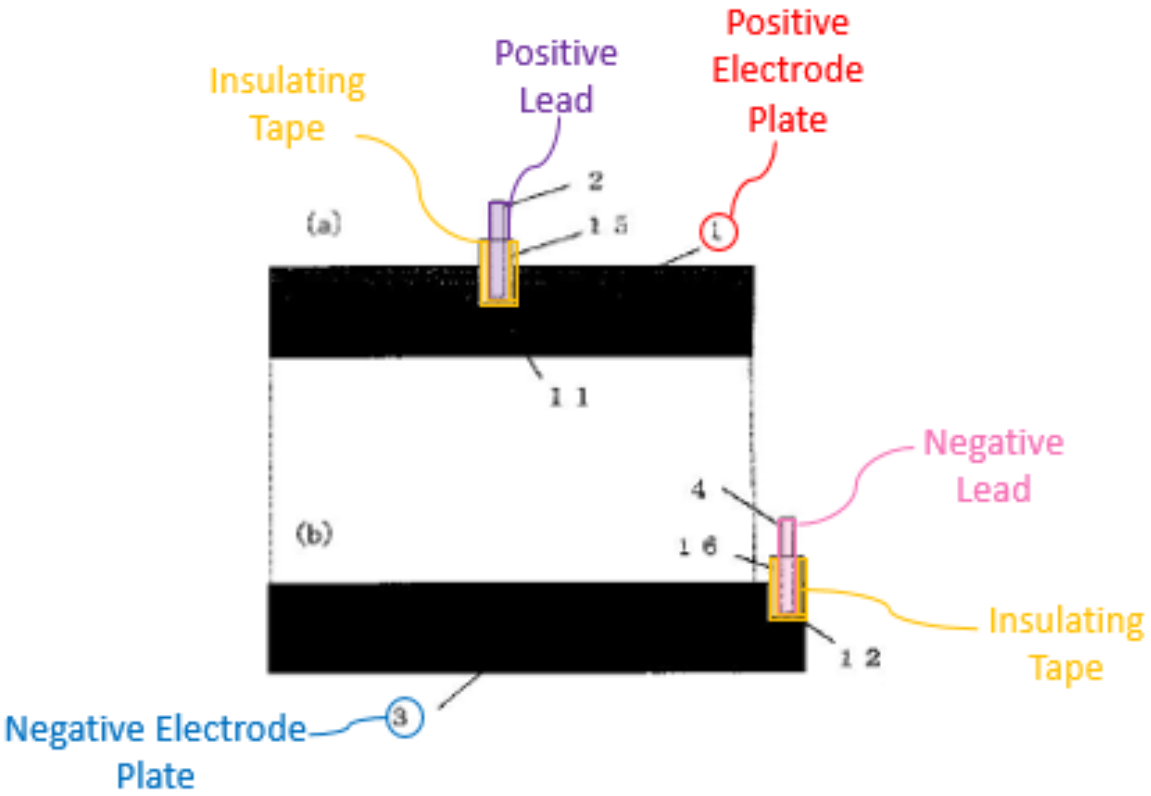

Sato, Positive Electrode

## X. GROUND 2: CLAIMS 4, 5, 7, AND 18 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO AND TAKEMURA, FURTHER IN VIEW OF NAKAMURA.

### A. Japanese Patent Pub. No. JP 2003-068271 to Nakamura *et al.* (Nakamura)

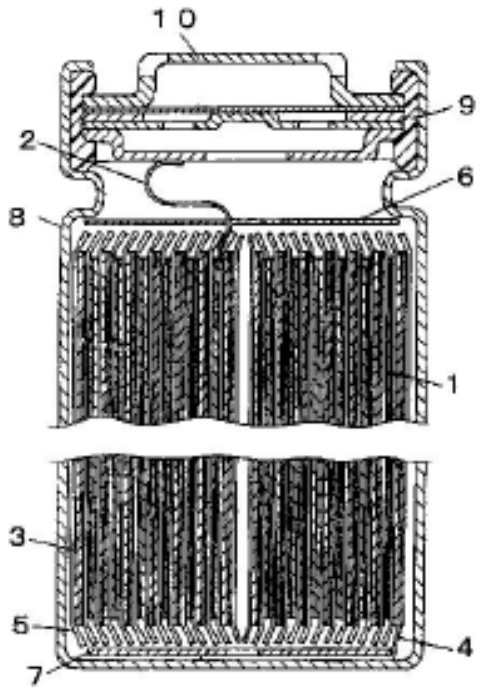
185. Japanese Patent Pub. No. 2003-068271 to Nakamura *et al.* published on March 7, 2003. Nakamura's publication date precedes the '498 patent's earliest effective filing date of January 17, 2014 by over 10 years.

186. Nakamura discloses a "lithium secondary battery" similar to those described in Sato and the '498 patent. EX1012, ¶[0007]. Nakamura's lithium-ion battery includes a positive electrode plate 1 formed by a positive electrode current collector and a positive electrode active material applied to the surfaces of positive current collector. EX1012, ¶[0012]. Nakamura's lithium-ion battery also includes a negative electrode plate 3 formed by a negative electrode current collector and a negative electrode active material applied to the surfaces of negative current collector. EX1012, ¶[0029]. Nakamura's lithium-ion battery includes a positive electrode lead 2 connected to positive electrode plate 1 and a negative electrode lead 4 connected to negative electrode plate 3. EX1012, ¶¶[0026], [0027], [0034].



EX1012, FIG. 1 (annotated).

187. Nakamura discloses similar fabrication attributes as Sato, Takemura, and the ’498 patent, such as applying the active-material paste on the current collector foils and spirally winding the positive and negative electrodes within a battery case 8. EX1012, ¶¶[0012], [0025], [0029], [0054]. Nakamura also discloses stripping active material from the positive electrode plate 1 to form a positive electrode active material-free portion 11 (i.e., a first recess) that is connected to positive electrode lead 2 and a negative electrode active material-free portion 12 (i.e., a second recess) that is connected to negative electrode lead 4. EX1012, ¶¶[0027], [0039]-[0053]. Nakamura’s battery also includes a separator 5 interposed between the positive electrode plate 1 and negative electrode plate 3. EX1012, ¶[0025].




EX1012, FIG. 2.

188. To minimize the amount of positive electrode active material removed from the positive electrode plate to form the active material-free portion 11 (i.e., a first recess), Nakamura discloses maintaining the width of active material-free portion 11 in a range from 5 mm to 15 mm and the length of active material-free portion at 6 mm. EX1012, ¶¶[0027], [0052]. Similarly, Nakamura discloses maintaining the length of the negative active material-free portion 12 at 5.5 mm to minimize the amount of negative electrode active material removed from the negative electrode plate. EX1012, ¶[0053]. Forming the active material-free portions according to the dimensions taught by Nakamura enlarges the volume of positive active material opposing the negative electrode, which improves battery

storage capacity, thereby allowing the battery to supply power for an extended period of time without recharging. EX1012, ¶¶[0007]-[0008], [0069]-[0073].

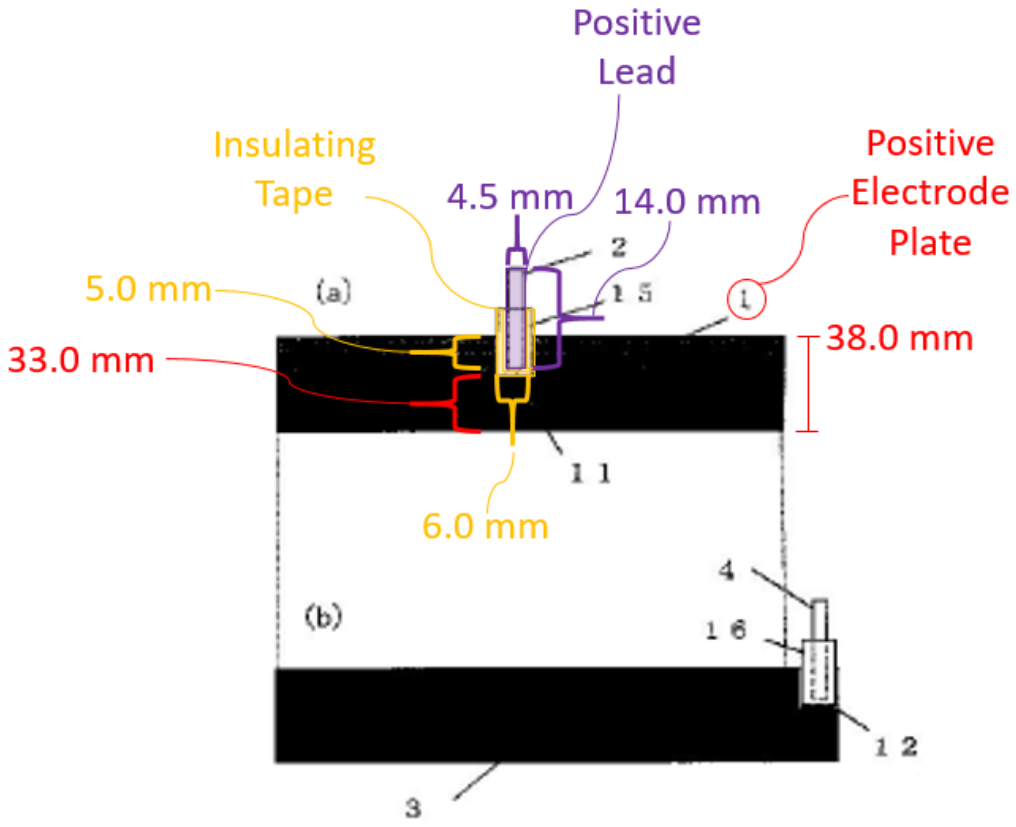
### B. A POSA would have been motivated to combine Nakamura with Sato and Takemura with a reasonable expectation of success.

189. Nakamura, Sato, and Takemura are analogous art as they all disclose coiled lithium-ion battery cells. EX1005, ¶[0001]; EX1006, ¶[0001]; EX1012, ¶[0007]. Sato, Takemura, and Nakamura disclose non-aqueous electrolyte coiled lithium-ion battery cells with insulating tapes configured to enhance reliability and prevent safety hazards within the battery cells. EX1005, ¶¶[0010], [0113]; EX1012, ¶¶[0025], [0028], [0034]-[0035], [0054].

190. Nakamura discloses dimensions—the width and length—of the active material-free portions (i.e., first and second recesses) on the positive and negative electrode plates within certain ranges to minimize the amount of active material removed from the electrode current collector when forming material-free portions (i.e., recesses) in the electrodes while exposing enough surface of the current collector to spot-weld the lead. EX1012, ¶¶[0027], [0052]-[0053]. Preserving more active material on the electrode's current collector improves the storage capacity of the battery. EX1012, ¶¶[0005]-[0008], [0069]-[0073].

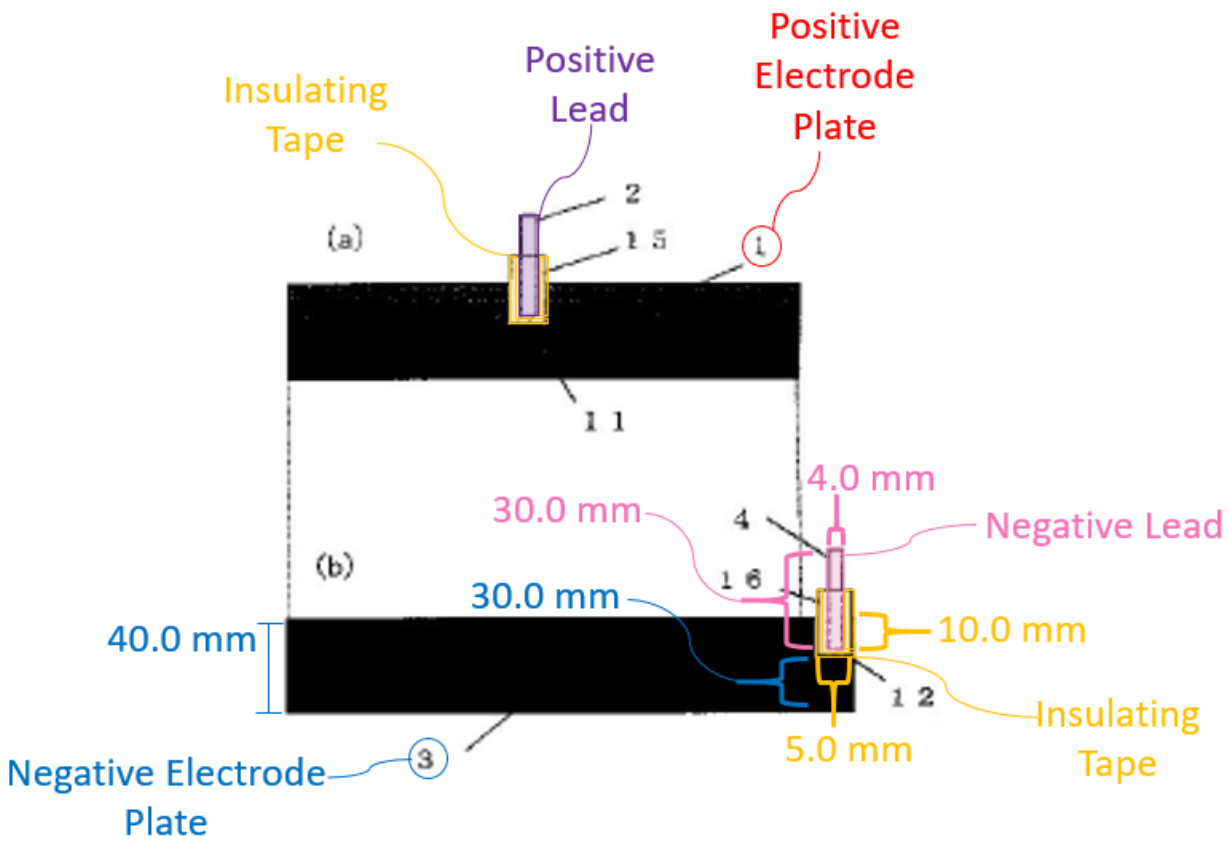
191. Specifically, Nakamura discloses the width (measured along a length direction of the positive electrode plate) of positive active material-free portion 11 (i.e., a first recess) to be "1 mm to 2 mm wider than the width of the positive

electrode lead 2 in the longitudinal direction." EX1012, ¶27. For example, Nakamura discloses providing a positive active material-free portion 1 (i.e., a first recess) in a positive electrode plate 1 with a width of 6.0 mm (measured along a length of the positive electrode plate) and a length of 5 mm (measured along a width of the positive electrode), and providing a positive lead 2 with a width of 4.5 mm (measured along a length of the positive electrode plate). EX1012, ¶[0052]. Nakamura further discloses providing the "positive electrode plate 1 with a width dimension of 38 mm and a length dimension of 355 mm." EX1012, ¶[0052]. These dimensions are illustrated in the following annotated figure.




EX1012, FIG. 1 (annotated).

192. Nakamura further discloses providing the length (measured along the width of the electrode plate) of a material free portion 12 in a negative electrode plate 3 in a "range from 5 mm to 15 mm" to "reduc[e] the number of leads and amount of insulating tape used," thereby reducing the manufacturing cost of the battery. EX1012, ¶[0034]. For example, Nakamura further discloses providing a negative active material-free portion 12 (i.e., a second recess) in a negative electrode plate 3 with a length of 10.0 mm (measured along a width of the negative electrode plate) and a width of 5.0 mm (measured along a length of the negative electrode plate). EX1012, ¶¶[0049], [0053]. These dimensions are illustrated in the annotated figure below. Nakamura discloses providing a negative lead 4 with a length of 30.0 mm (measured along a width of the negative electrode) and a width of 4.0 mm (measured along a length of the negative electrode plate). EX1012, ¶[0053]. Nakamura further discloses providing the "negative electrode plate 3 with a width dimension of 40 mm and a length dimension of 430 mm." EX1012, ¶[0053].




EX1012, FIG. 1 (annotated).

193. To the extent that Sato does not explicitly disclose all the claimed ranges of dimensions for the recesses of the '498 patent's positive and negative electrodes, it would have been obvious to a POSA to modify the dimensions of the recesses of Sato's positive and negative electrodes according to dimensions taught in Nakamura. Such modification would have been obvious to improve the storage capacity of Sato's battery while exposing enough current collector surface to weld the leads. EX1012, ¶¶[0027], [0073]. Such modification would have preserved more active material on the current collector of the electrode plate, thereby increasing the storage capacity of the battery. EX1012, ¶¶[0005]-[0008], [0069]-

[0073]. Thus, a POSA would have been motivated to combine the teachings of Nakamura's recess dimensions with Sato because doing so would have increased the storage capacity of Sato's battery. By keeping the area of the recess small, the area of the active material is maximized, which in turn maximizes the storage capacity of the battery..

194. A POSA would also have had a reasonable expectation of success in combining the teachings of Nakamura with Sato and Takemura because modifying the dimensions of the active material coated on the current collector was common in lithium-ion batteries well before 2014. *See* EX1012, ¶¶[0005]-[0008], [0069]-[0073]. A POSA would have expected Sato's electrodes, as modified by Takemura and Nakamura, to perform their intended function. Combining the teachings of Nakamura's recess dimensions with Sato's battery, as modified by Takemura, would have amounted to nothing more than applying a known technique—Nakamura's recess dimensions—to a known device—Sato's battery as modified by Takemura—to achieve the expected result of increasing the battery's storage capacity.

### C. The combination of Sato, Takemura, and Nakamura discloses or renders obvious every element of claims 4, 5, 7, and 18.

195. The following explains how each claimed element of the '498 patent is disclosed by Sato, Takemura, and/or Nakamura. In view of Sato's, Takemura's, and Nakamura's disclosures, a POSA would have modified Sato in view of

Takemura and Nakamura to arrive at lithium-ion batteries as claimed in the '498 patent.

**1. 4. wherein the first recess has a length of 1-100 mm less than a length of the positive lead, the first recess has a width of 1-10 mm larger than a width of the positive lead, the second recess has a length of 1-100 mm less than a length of the negative lead, and the second recess has a width of 1-10 mm larger than a width of the negative lead.**

**a. Sato**

196. For one example battery (Battery 1), Sato discloses the first recess (exposed portion 12/14 on positive electrode 4) having a width (i.e., 8 mm) of 1-10 mm larger (i.e., 2 mm) than a width (i.e., 6 mm) of the positive lead (lead 4L/11). EX1005, ¶¶[0111]-[0113]. Specifically, Sato discloses that "a portion where the positive electrode current collector was exposed had a width of 8 mm from the position of 278 mm to the position of 286 mm in the length direction relative to the end." EX1005, ¶[0111]. Sato further discloses that "[a]n aluminium positive electrode lead (with a width of 6 mm) was attached to the lead connection surface from which the mixture layer of the positive electrode current collector had been peeled off." EX1005, ¶[0113]. A POSA would have understood that Sato's first recess (exposed portion 12/14 on positive electrode 4) has a width that is 2 mm larger than the width of positive lead 4L/11.

197. Furthermore, Sato discloses the second recess (exposed portion 12/14 on negative electrode 5) having a width (i.e., 6 mm) that is 1-10 mm larger than a

width (i.e., 4 mm) of the negative lead (lead 5L/11). EX1005, ¶¶[0112], [0137]. Specifically, Sato discloses that "a nickel negative electrode lead (with a width of 4 mm) was attached to the negative electrode current collector." EX1005, ¶[0112]. Sato also discloses "a portion where the negative electrode current collector was exposed had a width of 6 mm from the position of 372 mm to the position of 378 mm relative to an end of the negative plate in the length direction." EX1005, ¶[0137]. A POSA would have understood that Sato's second recess (exposed portion 12/14 on negative electrode 5) has a width that is 2 mm larger than the width of negative lead 5L/11.

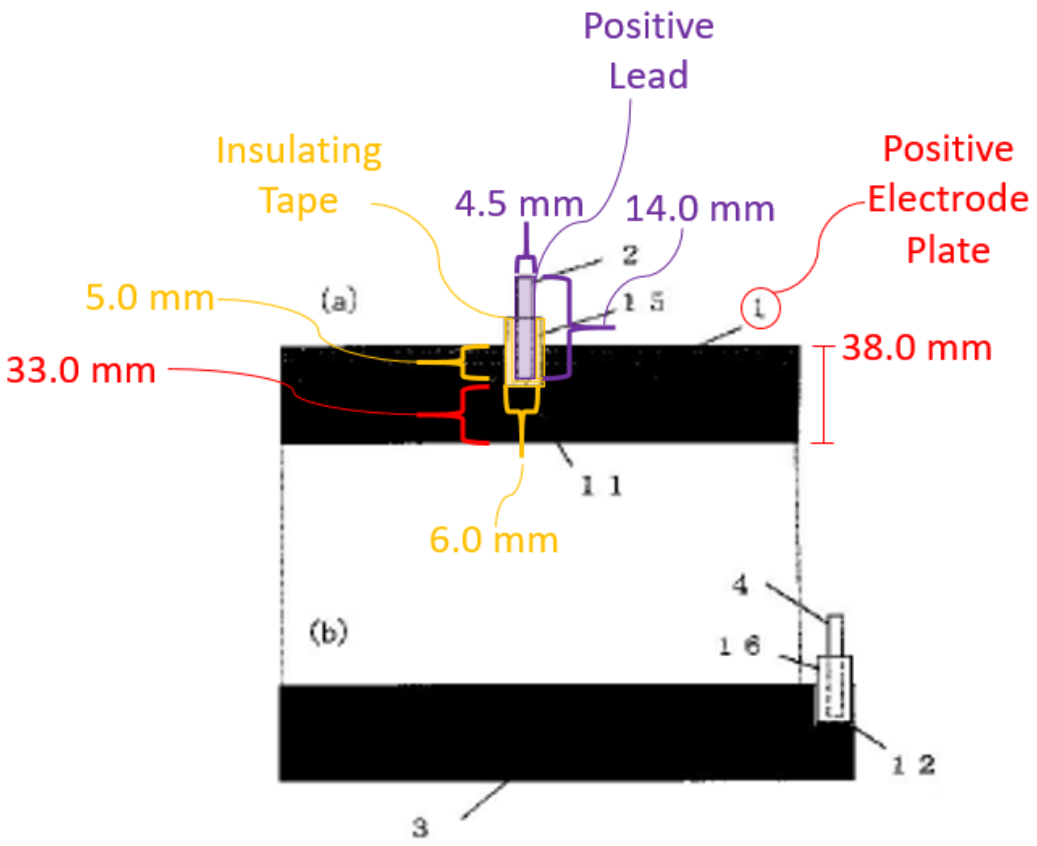
198. Sato is silent about "the first recess has a length of 1-100 mm less than a length of the positive lead" and "the second recess has a length of 1-100 mm less than a length of the negative lead." However, providing recesses on positive and negative electrodes with a length of 1-100 mm less than a length of a positive and negative lead was well known, as evidenced by Nakamura.

**b. Nakamura**

199. To the extent Sato does not explicitly disclose the recesses having the lengths as claimed, Nakamura discloses that modifying the length of the electrode's recesses to be within the recited dimension ranges of claim 4 would have been obvious.

200. As annotated in Figure 1, reproduced below, Nakamura discloses

providing a positive active material-free portion 11 (i.e., a first recess) in a positive electrode plate 1 with a length of 5.0 mm (measured along a width of the positive electrode plate) and a width of 6.0 mm (measured along a length of the positive electrode plate). EX1012, ¶[0052]. Nakamura discloses providing a positive lead 2 with a length of 14.0 mm (measured along a width of the positive electrode plate) and a width of 4.5 mm (measured along a length of the positive electrode plate). EX1012 ¶[0052]. A POSA would have understood that Nakamura's first recess (material-free portion 11) has a length of 9.0 mm less than a length of positive electrode lead 2 (positive lead's 14.0 mm length – positive material-free portion's 5 mm length). A POSA would also have understood that Nakamura's first recess (material-free portion 11) has a width of 1.5 mm larger than a width of the positive lead 2 (positive material-free portion's 6.0 mm width – positive lead's 4.5 mm width).




EX1012, FIG. 1 (annotated).

201. As annotated also in Figure 1, reproduced below, Nakamura discloses providing a negative active material-free portion 12 (i.e., a second recess) in a negative electrode plate 3 with a length of 10.0 mm (measured along a width of the negative electrode plate) and a width of 5.0 mm (measured along a length of the negative electrode plate). EX1012, ¶¶[0049], [0053].[7] Nakamura discloses

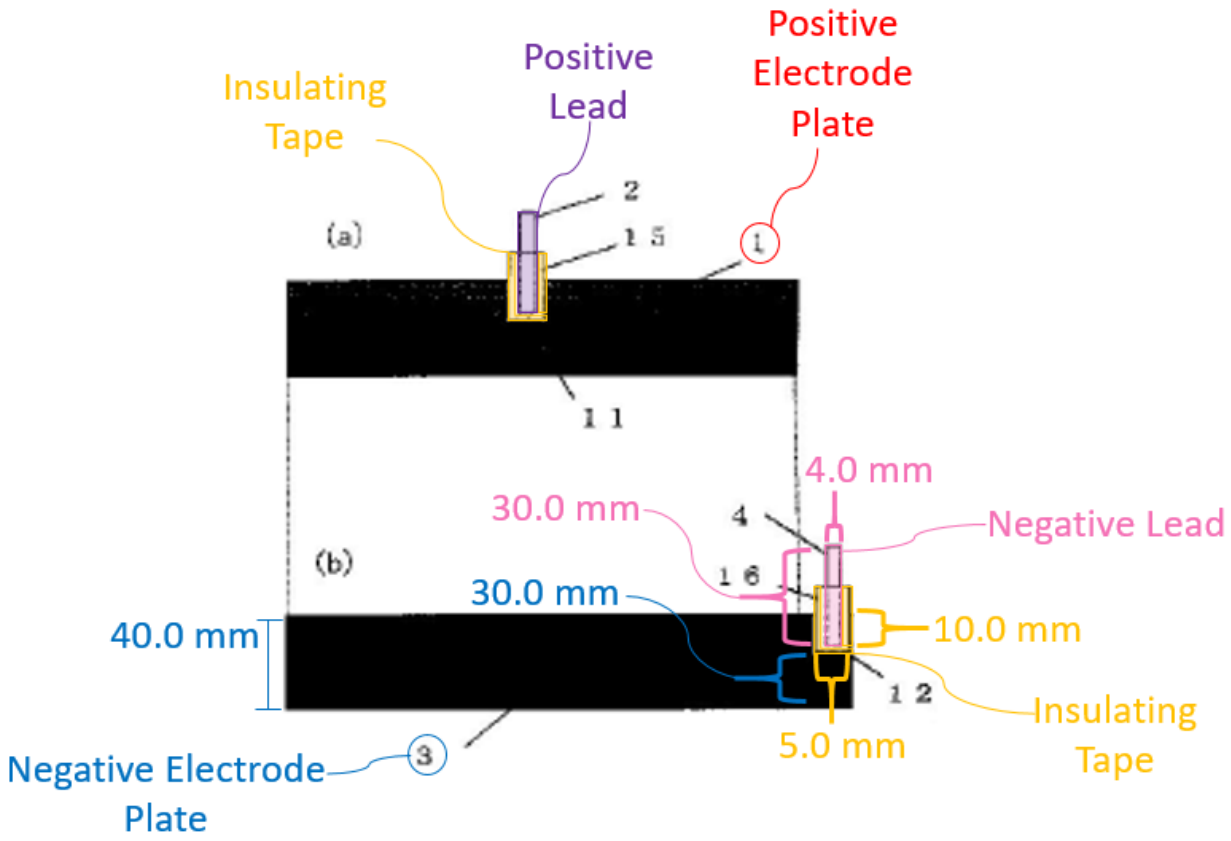
[7] There is a discrepancy in Nakamura's written disclosure regarding the length dimension of the second recess (measured along the width of Nakamura's

providing a negative lead 4 with a length of 30.0 mm (measured along a width of the negative electrode) and a width of 4.0 mm (measured along a length of the negative electrode plate). EX1012, ¶[0053]. A POSA would have understood that Nakamura's second recess (material-free portion 12) has a length of 20 mm less than a length of the negative electrode lead 4 (lead's 30.0 mm length – negative material-free portion's 10.0 mm length). A POSA would have understood that Nakamura's second recess (material-free portion 12) has a width of 1.0 mm larger

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negative electrode plate). Paragraph [0049] of Nakamura describes that the "active material to form a free portion to weld the negative electrode lead 4" are stripped "10.0 mm in the width direction and 5.0 mm in the longitudinal direction." In contrast, paragraph [0053] of Nakamura describes that the "negative electrode active material-free portion 12 with a width dimension of 30 mm and a length dimension of 5.5 mm." A POSA would have understood that Nakamura's 30 mm width dimension in paragraph [0053] is not accurate based on the remaining written disclosure. *See* EX1012, ¶[0034], (describing a recess width in "a range from 5 mm to 15 mm" for the material free portion 12 on "negative electrode plate 3"). My analysis relies on the written description of paragraph [0049] referring to Fig. 1 of Nakamura in the context of the negative lead dimensions of paragraph [0053].

than a width of the negative lead 4 (negative material-free portion's 5.0 mm width – negative lead's 4.0 mm width).




EX1012, FIG. 1 (annotated).

202. Further, even assuming that paragraph [0053] of Nakamura correctly describes that negative active material-free portion 12 has a length (measured along the width of electrode plate) of 30 mm,[8] a POSA would have been motivated

[8] As I explained above in footnote 7, a POSA would have understood that the 10 mm length ("10.0 mm in the width direction") of negative material-free

to form the length of negative active material-free portion 12 in its "preferred" range of "5 mm to 15 mm," as described in paragraph [0034]. Specifically, Nakamura describes that reducing the length of negative active material-free portion 12 to be significantly less than the width of negative electrode plate 3 reduces the "amount of insulating tape" used to cover the exposed metal of negative electrode plate 3, thereby "lowering production costs." EX1012, ¶[0034]. Forming the length of negative active material-free portion 12 in the battery embodiment described in paragraph [0053] according to the preferred range of 5 mm to 15 mm described in paragraph [0034] results in Nakamura's second recess (material-free portion 12) having a length of 15 mm to 25 mm less than a length of the negative electrode lead 4 (lead's 30.0 mm length – negative material-free portion's 5 mm to 15 mm length). Thus, a POSA would have understood that Nakamura discloses or at least renders obvious recess dimensions that overlap the recess dimension ranges recited in claim 4.

**c. Combination of Sato, Takemura, and Nakamura.**

203. In view of Sato's, Takemura's, and Nakamura's disclosures, it would

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portion 12 described in paragraph [0049] applies to negative active material-free portion 12 described in paragraph [0053] to be consistent with the remaining disclosure (e.g., paragraph [0034] and Figure 1) of Nakamura.

have been obvious to a POSA to form the length of Sato's first and second recesses to be 1-100 mm less than a length of the positive and negative leads. Modifying the length of Sato's recesses, as taught by Nakamura, would have preserved more active material applied to the electrode's current collector, thereby increasing the capacity of Sato's battery, as modified by Takemura. Increasing the storage capacity of Sato's battery would allow Sato's battery to supply power for an extended period of time. EX1012, ¶¶[0008], [0069]-[0073]. Modifying the length of Sato's first and second recesses to be 1-100 mm less than a length of the positive and negative leads would have simply been applying a known technique (modifying the dimensions of the electrode's recesses) to a known device (Sato's battery as modified by Takemura) to achieve the predictable result of improving the battery's storage capacity and reducing manufacturing costs.

204. Accordingly, a POSA would have understood that the combined disclosures of Sato, Takemura, and Nakamura render claim 4 obvious.

**2. 5. wherein the first recess has a length of 1-100 mm less than a width of the positive electrode active material layer, and the second recess has a length of 1-100 mm less than a width of the negative electrode active material layer.**

**a. Sato**

205. For one example (Battery 1), Sato discloses applying a coating of an electrode material mixture layer to a positive electrode plate having a width of 57 mm. EX1005, ¶[0104]. Recognizing that Sato's material mixture layer is applied

across the width of the electrode plate, a POSA would have understood that the width of Sato's positive active material layer corresponds to the width of the electrode plate—57 mm.

206. Similarly, for Battery 8, Sato discloses applying a coating of an electrode material mixture layer to a negative electrode plate having a width of 58.5 mm. EX1005, ¶[0107]. Recognizing that Sato's material mixture layer is applied across the width of the electrode plate, a POSA would have understood that the width of Sato's negative active material layer corresponds to the width of the electrode plate—58.5 mm.

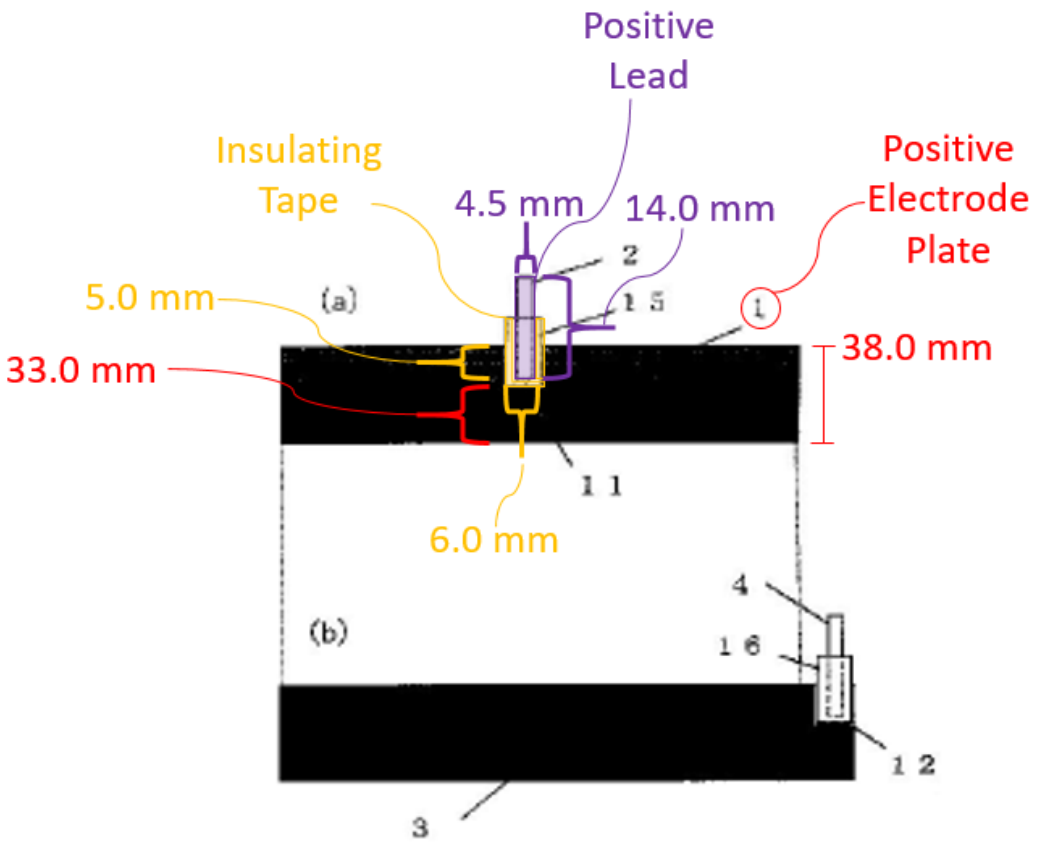
207. Sato is silent about "the first recess has a length of 1-100 mm less than a width of the positive electrode active material layer" and "the second recess has a length of 1-100 mm less than a width of the negative electrode active material layer." However, providing recesses on positive and negative electrodes with a length of 1-100 mm less than a width of a positive and negative electrode active material layer was well known, as evidenced by Nakamura.

**b. Nakamura**

208. To the extent Sato does not explicitly disclose the first recess having a length of 1-100 mm less than a width of a positive electrode active material layer and the second recess having a length of 1-100 mm less than a width of a positive electrode active material layer, Nakamura discloses that modifying the length of

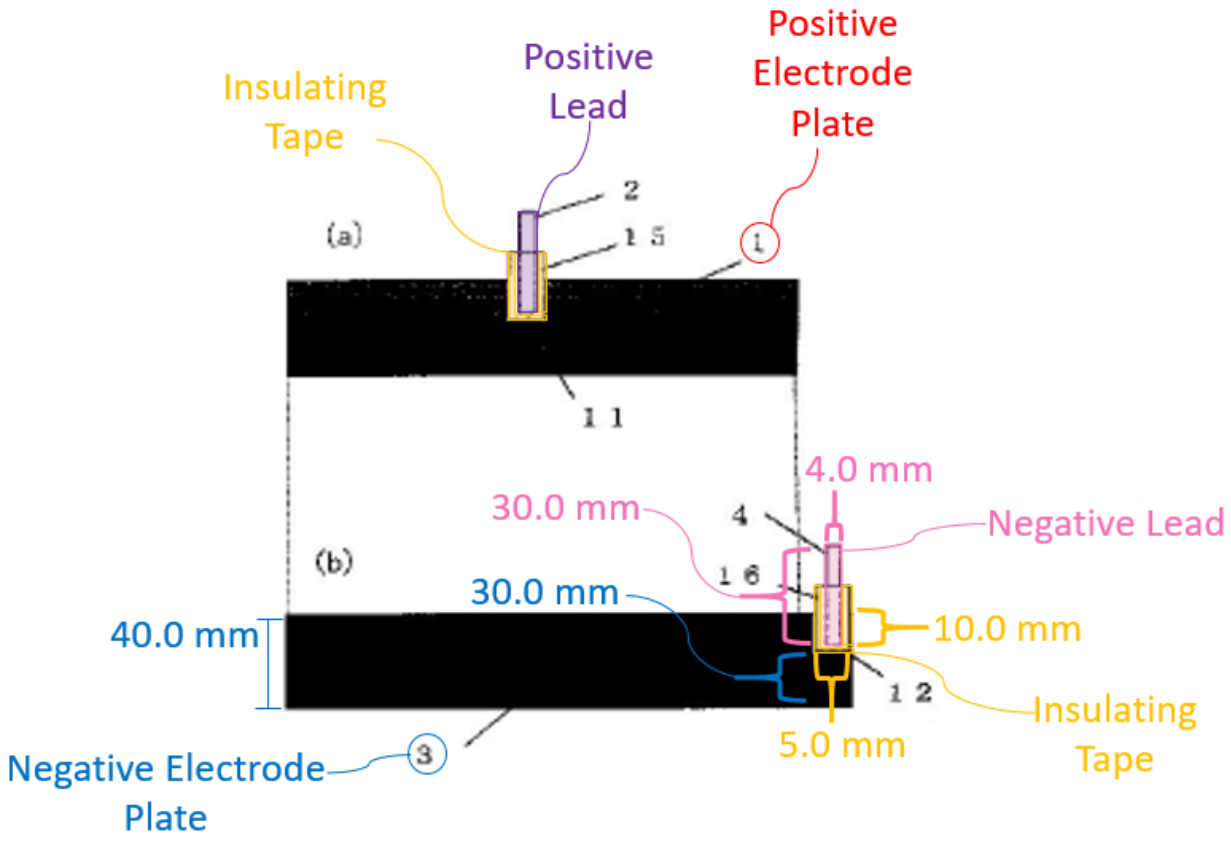
the electrode's recesses to be within the recited dimension ranges of claim 5 would have been obvious.

209. Nakamura discloses providing a positive active material-free portion 11 (i.e., the first recess) in a positive electrode plate 1 with a length of 5.0 mm (measured along a width of the positive electrode plate). EX1012, ¶[0052]. Nakamura's positive electrode plate 1 has "a width dimension of 38 mm." EX1012, ¶[0052]. Recognizing that the width of Nakamura's active material mixture layer corresponds to the width of the electrode plate, a POSA would have understood that the length of Nakamura's first recess (material-free portion 11) is 33 mm less than a width of positive electrode active-material layer (38 mm– 5 mm), as annotated in Figure 1, reproduced below.




EX1012, FIG. 1 (annotated).

210. Nakamura further discloses providing a negative active material-free portion 12 (i.e., the second recess) in a negative electrode plate 3 with a length of 10.0 mm (measured along a width of the negative electrode plate). EX1012, ¶¶[0049], [0053]. Nakamura's negative electrode plate 3 has "a width dimension of 40 mm." EX1012, ¶[0053]. Recognizing that the width of Nakamura's material mixture layer corresponds to the width of the electrode plate, a POSA would have understood that the length of Nakamura's second recess (material-free portion 12) is 30 mm less than a width of negative electrode active-material layer (40 mm – 10 mm), as annotated in Figure 1, reproduced below.




EX1012, FIG. 1 (annotated).

211. Further, even assuming that paragraph [0053] of Nakamura correctly describes that negative active material-free portion 12 has a length (measured along the width of electrode plate) of 30 mm,[9] a POSA would have been motivated

[9] As I explained above in footnote 7, a POSA would have understood that the 10 mm length ("10.0 mm in the width direction") of negative material-free portion 12 described in paragraph [0049] applies to negative active material-free

to form the length of negative active material-free portion 12 in its "preferred" range of "5 mm to 15 mm," as described in paragraph [0034]. Specifically, Nakamura describes that reducing the length of negative active material-free portion 12 to be significantly less than the width of negative electrode plate 3 reduces the "amount of insulating tape" used to cover the exposed metal of negative electrode plate 3, thereby "lowering production costs." EX1012, ¶[0034]. Forming the length of negative active material-free portion 12 in the battery embodiment described in paragraph [0053] according to the preferred range of 5 mm to 15 mm described in paragraph [0034] results in the length of Nakamura's second recess (material-free portion 12) being 25 mm to 35 mm less than a width of negative electrode active-material layer (40 mm – 5 mm to 15 mm). Thus, a POSA would have understood that Nakamura discloses or at least renders obvious first and second recess dimensions that overlap the recess dimension ranges recited in claim 5.

**c. Combination of Sato, Takemura, and Nakamura.**

212. In view of Sato's, Takemura's, and Nakamura's disclosures, it would have been obvious to a POSA to form the length of Sato's first and second recesses

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portion 12 described in paragraph [0053] to be consistent with the remaining disclosure (e.g., paragraph [0034] and Figure 1) of Nakamura.

to be 1-100 mm less than a width of the positive and negative electrode active material mixture layers. Modifying the length of Sato's recesses, as taught by Nakamura, would have preserved more active material applied to the electrode's current collector, thereby increasing the capacity of Sato's battery, as modified by Takemura. Increasing the capacity of Sato's battery would allow Sato's battery to supply power for an extended period of time. EX1012, ¶¶[0008], [0069]-[0073]. Modifying the length of Sato's first and second recesses to be 1-100 mm less than a width of the positive and negative electrode active material mixture layers would have simply been applying a known technique (modifying the dimensions of the electrode's recesses) to a known device (Sato's battery as modified by Takemura) to achieve the predictable result of improving the battery's storage capacity and reduce manufacturing costs.

213. Accordingly, a POSA would have understood that the combined disclosures of Sato, Takemura, and Nakamura render claim 5 obvious.

**3. 7 and 18. "wherein a length of a portion of the positive lead in the first recess is less than a width of a remaining portion of [a first film] the positive electrode active material layer from an edge of the first insulating glue layer covering the [first film] positive electrode active material layer to an edge of the [first film] positive electrode active material layer opposite to the first recess."**

214. The language of claim 7 is patentably indistinct from claim 18. *Compare* EX1001, 11:33-39 (claim 7) *with* 13:8-13 (claim 18). The only

distinction between claim 7 and claim 18 is that claim 7 recites the term "positive electrode active material layer," whereas claim 18 recites "a first film." A POSA would have understood that terms "positive electrode active material layer" and "first film" are patentably indistinct in the context of claims 7 and 18. Accordingly, my analysis below addresses all these claims at once.

**a. Sato**

215. For one example (Battery 1), Sato discloses applying a coating of an electrode material mixture layer to a positive electrode plate having a width of 57 mm. EX1005, ¶[0104]. Recognizing that Sato's material mixture layer is applied across the width of the electrode plate, a POSA would have understood that the width of Sato's positive active material layer corresponds to the width of the electrode plate—57 mm.

216. Sato also discloses that "a portion where the positive electrode current collector was exposed had a width of 8 mm from the position of 278 mm to the position of 286 mm in the length direction relative to the end." EX1012, ¶[0111]. Sato further discloses that "[a]n aluminum positive electrode lead (with a width of 6 mm) was attached to the lead connection surface from which the mixture layer of the positive electrode current collector had been peeled off." EX012, ¶[0113].

217. Sato is silent about the dimensions of the positive electrode's exposed portion 12/14 (i.e., the first recess) relative to a width direction of the positive

electrode 4 and the length of positive lead 4L/11. Accordingly, Sato does not explicitly disclose that "a length of a portion of the positive lead in the first recess is less than a width of a remaining portion of the positive electrode active material layer from an edge of the first insulating glue layer covering the positive electrode active material layer to an edge of the positive electrode active material layer opposite to the first recess."

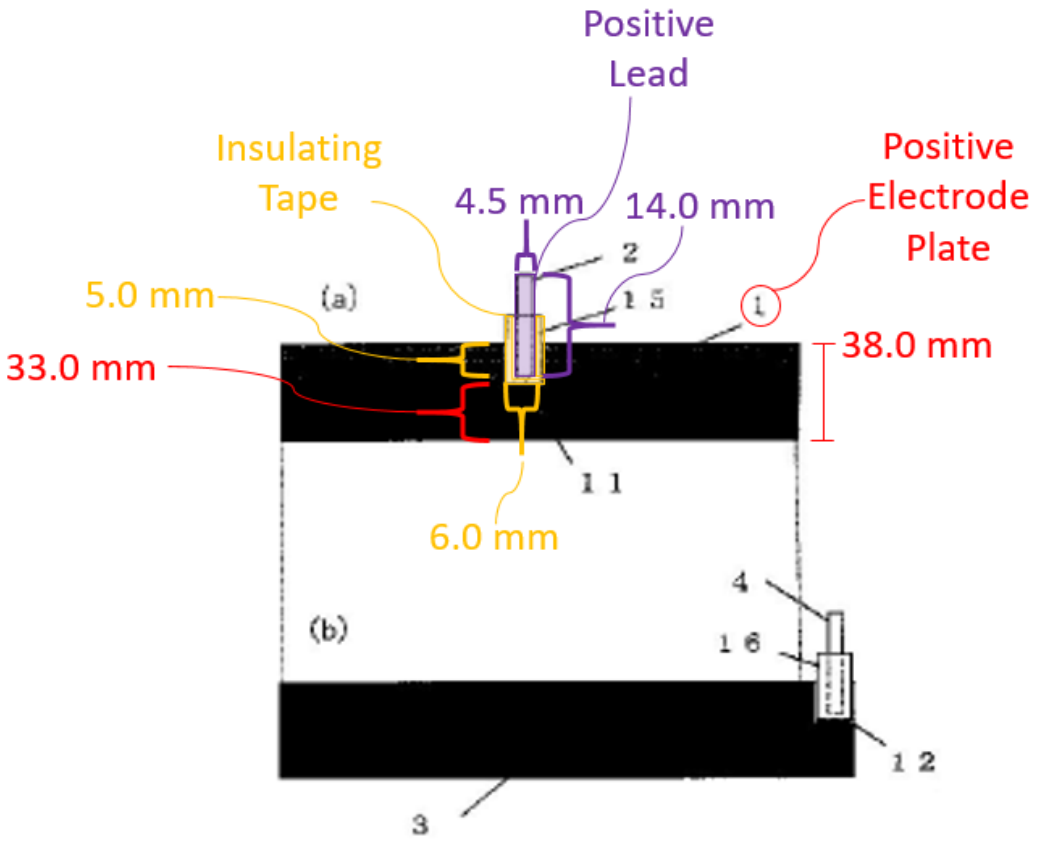
218. However, providing a lead in a first recess of a positive electrode with a length less than a width of a remaining portion of the positive electrode active material layer from an edge of the first insulating tape covering the positive electrode active material layer to an edge of the positive electrode active material layer opposite to the first recess was well known, as evidenced by Nakamura.

**b. Nakamura**

219. To the extent Sato does not explicitly disclose the recited dimension ranges of claims 7 and 18, Nakamura discloses that modifying the dimensions of the electrode's recesses and lead connection to be within the recited dimension ranges of claims 7 and 18 would have been obvious.

220. Nakamura discloses providing a positive active material-free portion 11 (i.e., a first recess) in a positive electrode plate 1 with a length of 5.0 mm (measured along a width of the positive electrode plate), as annotated in Figure 1 reproduced below. EX1012, ¶[0052]. Nakamura's positive electrode lead 2 is

"14.00 mm long." EX1012, ¶[0052]. A POSA would have understood that the length of the portion of positive electrode lead 2 located in material-free portion 11 is less than the length of material-free portion 11. EX1012, FIG. 1. Accordingly, the length of the portion of positive electrode lead 2 located in material-free portion 11 (i.e., the first recess) of Nakamura's positive electrode plate 1 is less than 5.0 mm.




EX1012, FIG. 1 (annotated).

221. Nakamura further discloses that positive electrode plate 1 has "a width dimension of 38 mm." EX1012, ¶[0052]. Recognizing that Nakamura's active material mixture layer is applied across the width of the electrode plate, a POSA

would have understood that the width of the remaining portion of Nakamura's active material mixture layer from an edge of the insulating tape 15 covering the positive electrode active material layer to an edge of the positive electrode active material layer opposite to the material-free portion 11 is 33.0 mm, as annotated above in Figure 1. Thus, the length (less than 5.0 mm) of the portion of Nakamura's positive lead 2 in material-free portion 11 is less than a width (33.0 mm) of the remaining portion of Nakamura's positive electrode active material layer defined from an edge of insulating tape 15 to an edge of the positive electrode active material layer opposite to material-free portion 11.

222. Thus, Nakamura discloses active material layer and recess dimensions that overlap the active material and recess dimensions ranges recited in claims 7 and 18.

**c. Combination of Sato, Takemura, and Nakamura.**

223. In view of Sato's, Takemura's, and Nakamura's disclosures, it would have been obvious to a POSA to make the length of a portion of Sato's positive lead 4L/11 in exposed portion 12/14 (i.e., the first recess) to be less than a width of a remaining portion of Sato's positive electrode active material layer 4B/9 defined from the edge of Sato's adhesive tape covering the positive lead 4L/11 to an edge of Sato's positive active material layer 4B/9 opposite to exposed portion 12/14. Modifying the dimensions of Sato's exposed portion 12/14 relative to a width

direction of positive electrode plate 4, as taught by Nakamura, would have preserved more active material applied to the electrode's current collector, thereby increasing the storage capacity of Sato's battery, as modified by Takemura. Increasing the storage capacity of Sato's battery would allow Sato's battery to supply power for an extended period of time. EX1012, ¶¶[0008], [0069]-[0073]. Modifying the length of Sato's lead 4L/11 in exposed portion 12/14 to be less than a width of the remaining portion of Sato's positive active material layer 4B/9 would have simply been applying a known technique (modifying the dimensions of the electrode's recesses) to a known device (Sato's battery as modified by Takemura) to achieve the predictable result of improving the battery's storage capacity.

224. Accordingly, a POSA would have understood that the combined disclosures of Sato, Takemura, and Nakamura render claims 7 and 18 obvious.

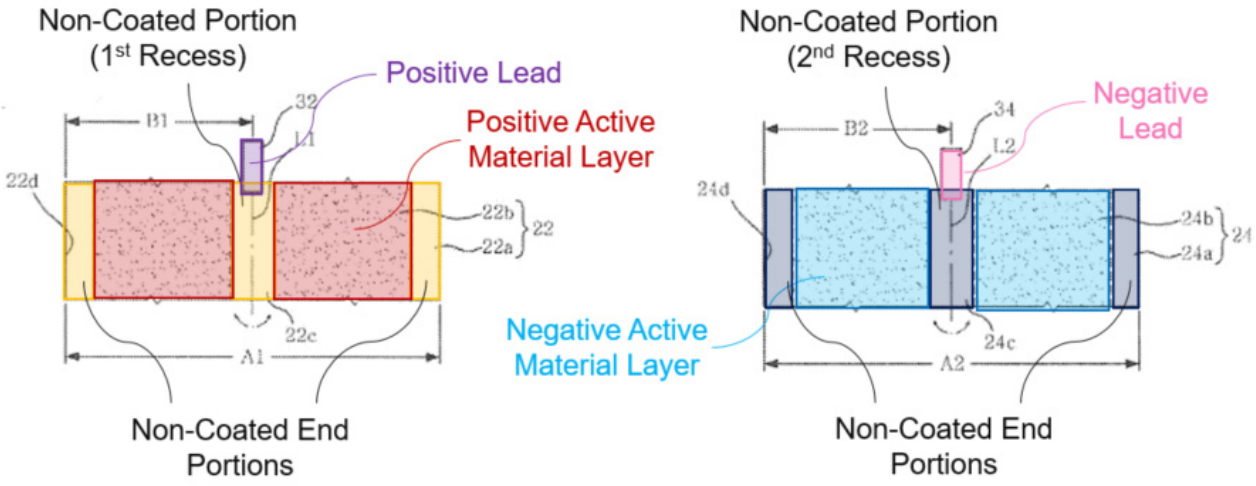
## XI. GROUND 3: DEPENDENT CLAIMS 20 AND 22 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO, TAKEMURA, OH-539, AND OH-144.

### A. U.S. Patent Pub. No. 2011/0104539 to Oh *et al.* (Oh-539)

225. U.S. Patent Pub. No. 2011/0104539 to Oh *et al.* is a national entry of PCT/KR2009/000379, filed on January 23, 2009, and published on May 5, 2011. Oh's publication date precedes the '498 patent's earliest effective filing date of January 17, 2014 by almost three years, and its international filing date precedes

the ’498 patent’s filing date by about five years.

226. Oh-539 discloses a lithium-ion battery (e.g., a pouch-type coiled battery) similar to those described in Sato, Takemura, Nakamura, Fujikawa, and the ’498 patent. EX1007, ¶[0092]. Oh-539’s battery includes a positive electrode (cathode) 22, a negative electrode (anode) 24, and a separator 12. EX1007, ¶[0039], FIG. 1. Oh-539’s positive electrode 22 includes a positive lead (cathode tab 32) attached to the positive electrode 22 within a first recess (non-coated portion 22c) formed in the positive active material (cathode active material 22b) on the positive electrode 22. EX1007, ¶¶[0039]-[0046], FIG. 2. Opposing end portions 22a of the positive electrode 22 are also not coated with the positive active material (cathode active material 22b). EX1007, ¶[0074]. Similarly, Oh-539’s negative electrode includes a negative lead (anode tab 34) attached to the negative electrode 24 within a second recess (non-coated portion 24c) formed in the negative active material (anode active material 24b) on the negative electrode 24. EX1007, ¶¶[0056]-[0059], FIG. 3. Opposing end portions 24a of the negative electrode 24 are also not coated with the negative active material (anode active material 24b). EX1007, ¶[0074].




EX1007, FIGs. 2, 3 (annotated).

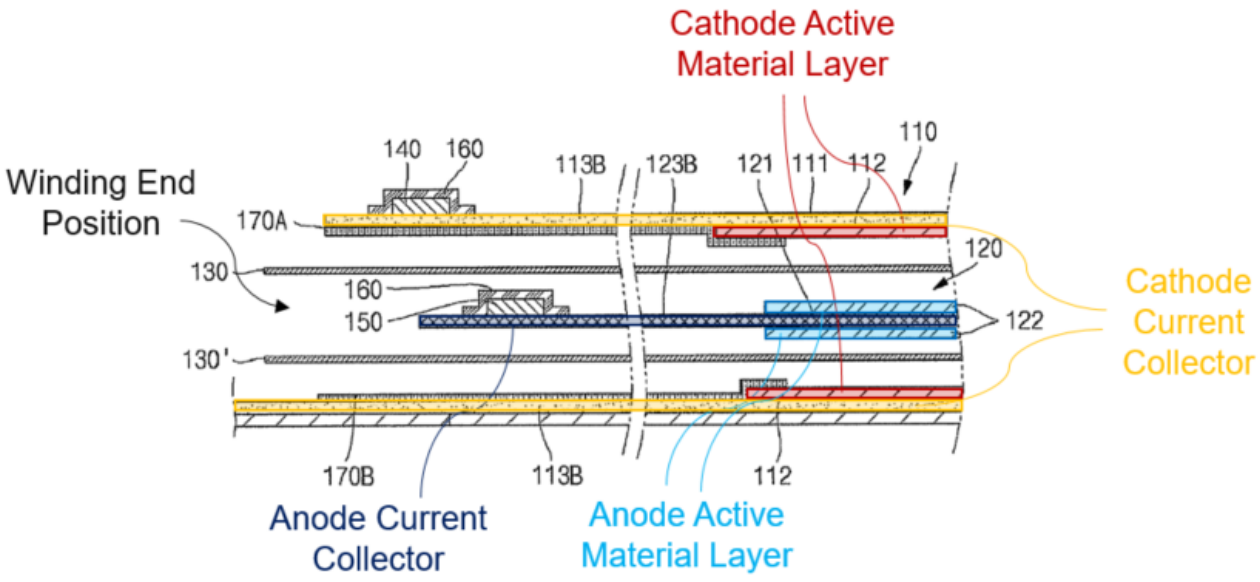
227. The center of Oh-539's first and second recesses (non-coated portions 22c, 24c) is located at distance B1/B2 that is 40% to 60% of the total length A1/A2 of Oh-539's positive electrode 22 and negative electrode 24, respectively. EX1007, ¶¶[0050]-[0051], [0061]-[0062]. Oh-539 explains that placing the positive and negative leads (tabs 32, 34) in centrally located recesses reduces the length that current must travel within the battery, compared to batteries having the leads located at or near the ends of the electrodes. EX1007, ¶¶[0007], [0009]-[0010]. By reducing the distance the current must travel, Oh-539 explains that the lithium-ion battery will exhibit improved high power characteristics, improved high-rate discharging characteristics, and improved reliability. EX1007, ¶¶[0007], [0009]-[0010], [0100]-[0105].

228. Oh-539's positive lead (cathode tab 32) and negative lead (anode tab 34) carry current to and from the positive electrode 22 and the negative electrode

24. Oh discloses that the positive lead (cathode tab 32) and negative lead (anode tab 34) can be attached to the positive electrode 22 and the negative electrode 24, respectively, via welding. EX1007, ¶¶[0046], [0059]

### B. U.S. Patent Pub. No. 2010/0035144 to Oh (Oh-144)

229. Oh-144 discloses a lithium-ion battery similar those described in Sato, Takemura, Nakamura, Oh-539, and the ’498 patent. Oh-144’s battery includes a positive electrode (cathode) plate 110, a negative electrode (anode) plate 120, and a separator 130. EX1017, ¶[0025], FIGs. 3, 4. Oh-144’s cathode plate 110 includes a cathode collector 111, a cathode active material layer 112, and uncoated cathode portions 113. EX1017, ¶[0026]. Oh-144’s anode plate 120 includes an anode collector 121, an anode active material layer 122, and uncoated anode portions 123. EX1017, ¶[0027]. The separator 130 is wound in a position between the cathode plate 110 and the anode plate 120. EX1017, ¶[0025]. “The uncoated portions at the winding end position are referred to as ‘rear uncoated cathode or anode portions 113B or 123B.’” EX1017, ¶[0032].




EX1017, FIG. 4 (annotated).

230. Oh-144 also discloses placing tapes, for example tapes 160, 170A, and 170B on the positive and negative electrode plates 110, 120 to prevent short circuiting within a battery coil, for example a pouch-type battery coil, a rectangular battery or a cylindrical battery. EX1017, ¶¶[0037]-[0039], [0041]-[0042], [0045]. Oh-144 discloses placing a first tape 170A to cover the bottom (inner side) surface of the uncoated cathode portion 113B above exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0038]. Similarly, Oh-144 discloses placing a second tape 170B to cover a top (outer side) surface of the uncoated cathode portion 113B below exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0039]. The outer side surface of the uncoated cathode portion 113B remains uncoated for approximately one complete revolution in the winding because this outer side surface would directly face the battery case around

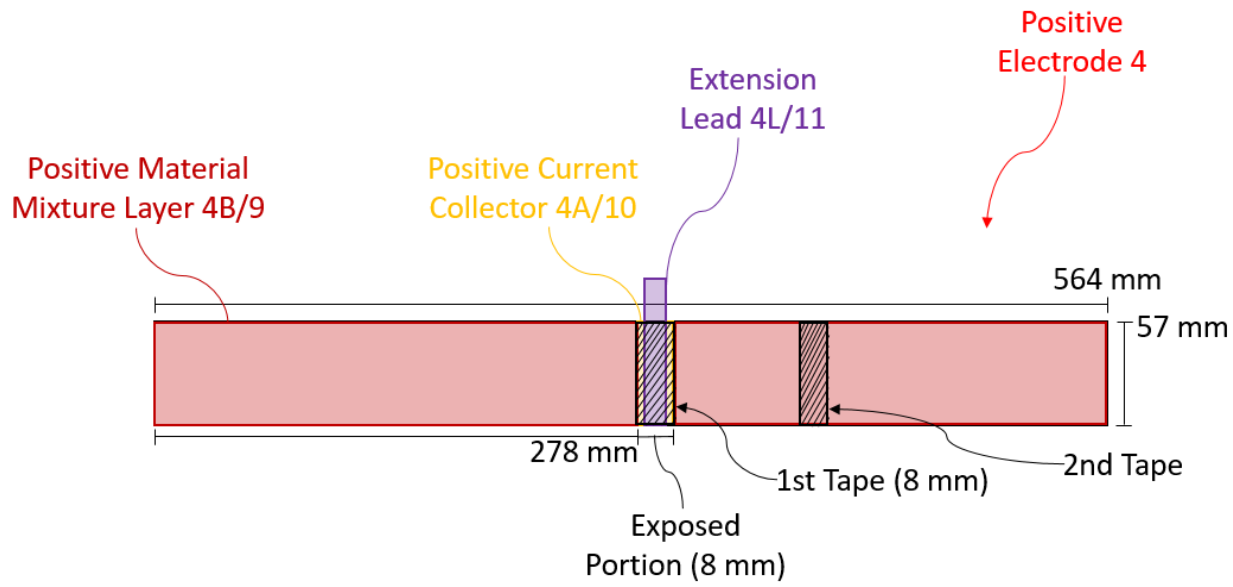
the perimeter of the coil. EX1017, ¶[0036], FIG. 3. Oh-144 explains that the position of these two tapes 170A, 170B prevents short circuits caused by contact between uncoated cathode and anode portions located at the winding end of the cathode and anode. EX1017, ¶¶[0037]-[0039].

### C. A POSA would have been motivated to combine Oh-539 and Oh-144 with Sato and Takemura with a reasonable expectation of success

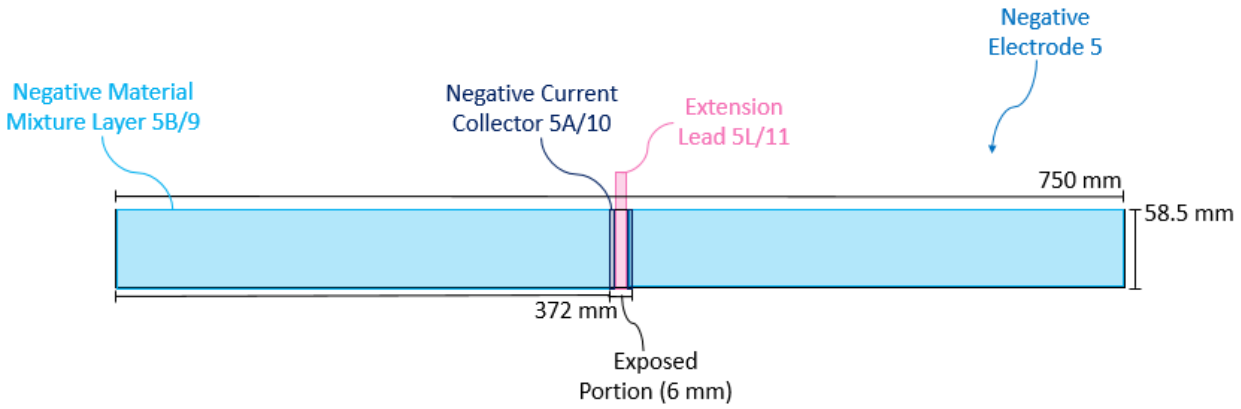
231. Sato, Takemura, Oh-539, and Oh-144 are analogous art as they all disclose coiled lithium-ion batteries. EX1005, ¶¶[0001], [0013]; EX1006, ¶[0001]; EX1007, ¶¶[0007], [0029]; EX1017, ¶¶[0025]-[0027]. They are from the same field and include the same building blocks—a positive electrode plate coated with positive active material, a positive lead attached to the positive electrode plate at an exposed portion, a negative electrode plate coated with negative active material, and a negative lead attached to the negative electrode plate at an exposed portion. EX1005, ¶[0010]; EX1006, ¶¶[0005], [0007]; EX1007, ¶¶[0039], [0045], [0058]; EX1017, ¶¶[0025]-[0027].

#### 1. Motivation to combine Oh-539 with Sato and Takemura

232. As I discussed above in Section IX, the combination of Sato with Takemura renders obvious a lithium-ion battery as recited in claims 1 and 17. In the combination of Sato and Takemura, the positive electrode and the negative electrode would have the following construction disclosed by Sato.




Sato's Positive Electrode.




Sato's Negative Electrode.

233. Sato describes making the positive electrode by applying a positive electrode material mixture slurry to both surfaces of an aluminum foil, drying the slurry on the foil to form a positive electrode plate, rolling and heat treating the plate, and then cutting the positive electrode plate to a desired width (e.g., 57 mm) and desired length (e.g., 564 mm). EX1005, ¶[0104]. After forming the plate, Sato

explains that positive active material was peeled from a center of the plate to form an exposed portion for the positive lead 11. EX1005, ¶[0111]. As illustrated above, a POSA would have understood Sato's positive electrode made by this method would include positive active material applied along the entire length of Sato's positive electrode (i.e., from end to end).

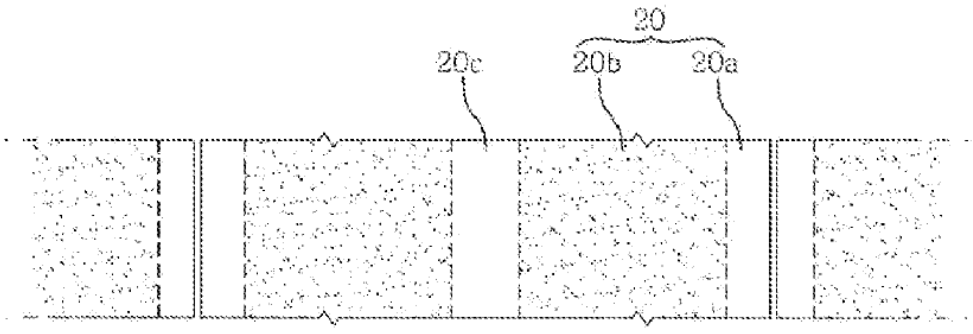
234. Similarly, Sato describes making the negative electrode by applying a negative electrode material mixture slurry to both surfaces of a copper foil, drying the slurry on the foil to form a negative electrode plate, rolling and heat treating the plate, and then cutting the negative electrode plate to a desired width (e.g., 58.5 mm) and desired length (e.g., 750 mm). EX1005, ¶[0107]. After forming the plate, Sato explains that negative active material was peeled from a center of the plate to form an exposed portion for the negative lead 11. EX1005, ¶[0137]. As illustrated above, a POSA would have understood Sato's negative electrode made by this method would include negative active material applied along the entire length of Sato's negative electrode (i.e., from end to end).

235. By cutting the electrodes to desired widths and lengths after coating and drying the positive and negative active materials, Sato's method would require cutting through the positive and negative active material at the opposing ends of the electrode. While this is a plausible way to make Sato's electrodes, a POSA would have understood that cutting through the active material could raise some

manufacturing concerns, including excessive wear on cutting tools and excessive formation of potentially harmful active material dust.

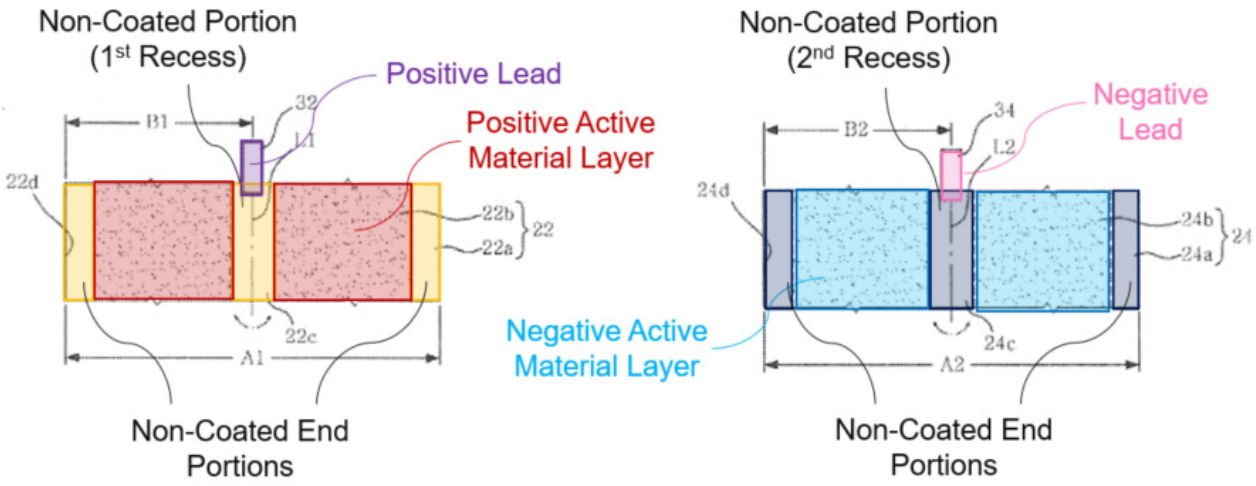
236. Accordingly, a POSA would have been motivated to look for alternative methods of making Sato's electrodes that reduce wear and/or reduce dust creation. Oh-539 discloses a method for making electrodes that would achieve both of these goals.

237. Oh-539 discloses a method for making electrodes that comprises applying positive and negative active materials on metal foils at regular intervals for ease of manufacturing. EX1007, ¶¶[0011], [0030], [0073]-[0075]. In particular, as illustrated in Figure 6(c), reproduced below, Oh-539 discloses applying active material 20 at regular intervals to formed exposed, non-coated portions 20c. EX1007, ¶¶[0030], [0074]. Then, Oh-539 cuts every other non-coated portion 20c to form electrodes comprising a center non-coated portion 20c and two opposing end non-coated portions. EX1007, ¶¶[0074]-[0075]. Thereafter, leads are attached to the center non-coated portion 20c of each electrode. EX1007, ¶[0076].



EX1007, FIG. 6(c).

238. The following annotated figures, show the construction of Oh-539's positive and negative electrodes after cutting and attaching the leads. According to Oh-539, this method of making electrodes is a simple, easily repeatable process capable of creating identical electrodes while keeping equipment cost low. EX1007, ¶[0075] ("existing equipment can be repetitively used, the cost increase due to equipment replacement can be reduced, and the electrodes 20 can be formed by a simple process").




EX1007, FIGs. 2 and 3 (annotated).

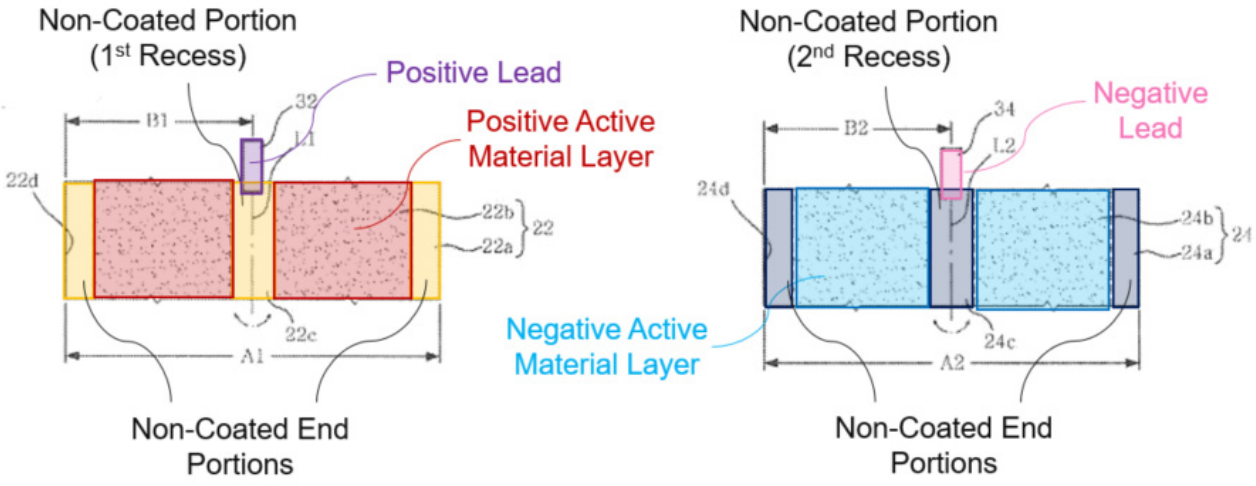
239. Therefore, a POSA would have been motivated to use Oh-539's method to make Sato's electrodes having centrally located recesses for the attachment of leads. Oh-539's method was a known method of cost-effectively creating electrodes with centrally located recesses like those disclosed in Sato. And using Oh-539's method to make Sato's electrodes would reduce cutting tool wear

and/or dust creation because Oh-539 cuts through only exposed, non-coated metal on the electrodes.

240. A POSA would have also had a reasonable expectation of success combining the teachings of Oh-539's method to create Sato's electrodes. Using Oh-539's method to create Sato's electrodes would have simply been applying a known, easily repeatable technique—coating and cutting electrode plates at regular intervals—to create a known electrode construction with centrally located recesses for the attachment of leads.

### 2. Motivation to combine Oh-144 with Sato, Takemura, and Oh-539

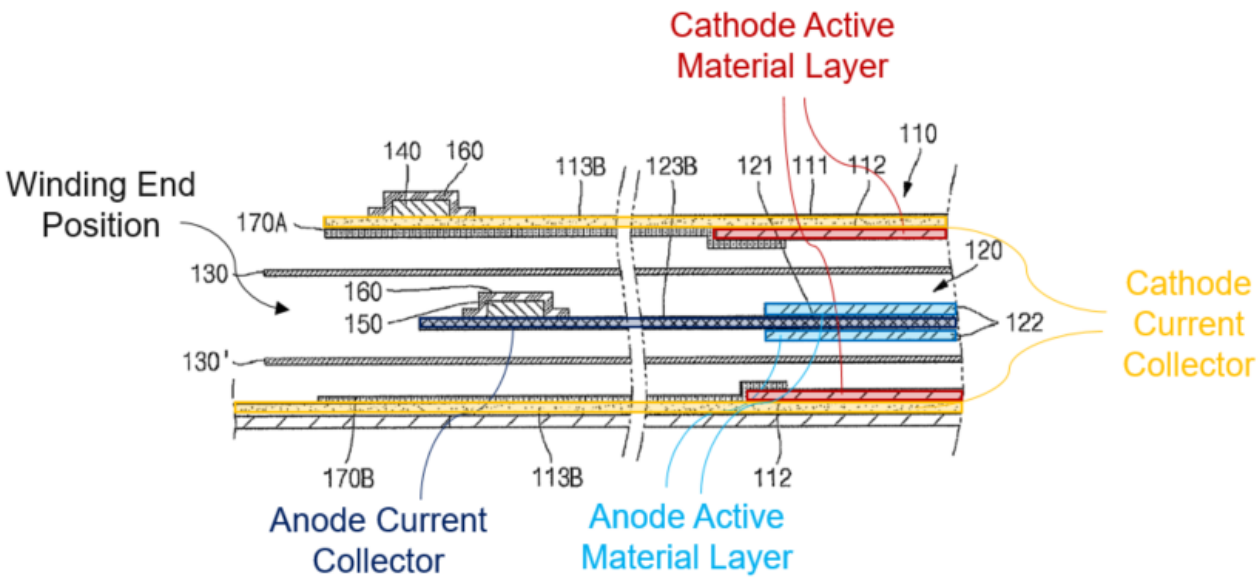
241. As I discussed in the previous Section, it would have been obvious to make the Sato-Takemura battery using Oh-539's method. This modification would result in the Sato-Takemura battery having electrodes with the same layout as Oh-539's electrodes, as shown in the following annotated figures.



EX1007, FIGs. 2 and 3 (annotated).

242. In the Sato-Takemura-Oh-539 battery, a POSA would have understood that exposed metal at the non-coated end portions could be susceptible to short-circuiting when the electrodes are wound with a separator to form the battery. EX1008, ¶[0005]; EX1011, ¶[0009]; EX1017, ¶¶[0010], [0011]. Accordingly, a POSA would have been motivated to look for a battery construction that would help prevent such short-circuiting.

243. Oh-144 discloses a lithium-ion battery with a positive electrode (cathode) plate 110, a negative electrode (anode) plate 120, and a separator 130 wound between the cathode plate 110 and the anode plate 120. EX1017, ¶[0025], FIGs. 3-4; Oh-144's cathode plate 110 includes a cathode collector 111, a cathode active material 112, and uncoated cathode portions 113. EX1017, ¶[0026]. Oh-144's anode plate 120 includes an anode collector 121, an anode active material 122, and uncoated anode portions 123. EX1017, ¶[0027]. "The uncoated portions at the winding end position are referred to as 'rear uncoated cathode or anode portions 113B or 123B.'" EX1017, ¶[0032].




EX1017, FIG. 4 (annotated).

244. Oh-144 also discloses disposing two tapes 170A, 170B on the cathode plate 110 at the winding end portion of the anode plate 120. EX1017, ¶¶[0038], [0039].

245. A first tape 170A covers the bottom (inner side) surface of the uncoated cathode portion 113B above exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0038]. Oh-144's tape 170A on the cathode plate 110 "corresponds to the outer surface of the rear anode uncoated portion 123B of the anode plate 120" to prevent "a short circuit that could be caused by contact between the rear cathode uncoated portion 113B of the cathode plate 110 and rear anode uncoated portion 123B of the anode." EX1017, ¶[0038].

246. A second tape 170B covers a top (outer side) surface of the uncoated cathode portion 113B below exposed metal 123B on the anode collector 121 at the

winding end. EX1017, ¶[0039]. Oh-144's second tape 170B "corresponds to the inner surface of the rear anode uncoated portion 123B of the anode plate 120" to prevent "a short circuit that could be caused by contact between the rear anode uncoated portion 123B of the anode plate 120 and rear cathode uncoated portion 113B of the cathode plate 110." EX1017, ¶[0039]. The outer side surface of the uncoated cathode portion 113B remains uncoated for approximately one complete revolution in the winding because this outer side surface would directly face the battery case around the perimeter of the coil. EX1017, ¶[0036], FIG. 3. Therefore, the second tape 170B is positioned at approximately one complete revolution in the winding such that its location corresponds to the inner surface of the rear anode uncoated portion 123B as shown in FIGS. 3 and 4.

247. A POSA would have been motivated to modify the Sato-Takemura-Oh-539 combination in view of Oh-144 to add the first and second tapes 170A, 170B. In making this modification, a POSA would have placed the two tapes on opposite inner and outer surfaces of the positive plate at the non-coated end portions created by Oh-539's manufacturing method such that (i) a winding end of the negative plate is located between the two tapes and (ii) the two tapes extend over the winding end as disclosed by Oh-144. Adding these two tapes would have helped prevent short circuits caused by contact between uncoated end portions on the cathode and anode located at the winding end of the battery coil. Oh-144

specifically teaches that positioning two tapes in this manner prevents short circuits in pouch-type or cylindrical wound battery coils, like those in Sato-Takemura-Oh-539. EX1005, ¶[0084]; EX1006, ¶[0032]; EX1007, ¶[0092]; EX1017, Abstract, ¶¶[0041]-[0042], [0045]. Further, improving short-circuit resistance within lithium-ion batteries by placing insulating tapes adjacent exposed metal on the anode was known well before January 2014. See e.g., EX1011, ¶¶[0009], [0014].

248. Adding insulating tapes as disclosed by Oh-144 would simply have been applying a known technique—placing tapes on inner and outer surfaces the positive electrode around exposed metal at the winding end of the negative electrode—to improve a known device—the Sato-Takemura-Oh-539 battery. Doing so would have helped prevent short circuits in the Sato-Takemura-Oh-539 battery.

249. A POSA would also have had a reasonable expectation of success combining Sato, Takemura, Oh-539, and Oh-144 because applying insulating tapes in coiled lithium-ion battery cells was a common solution for preventing short-circuiting within coiled lithium-ion batteries well before 2014. EX1006, ¶¶[0003], [0008], [0022]; EX1009, ¶[0008]; EX1010, ¶[0029]; EX1011, ¶[0009], [0014]; A POSA would have expected Oh-144's tapes 170A, 170B incorporated into the Sato-Takemura-Oh-539 battery to perform their intended function of insulating exposed metal to prevent short-circuiting between exposed metal at the winding

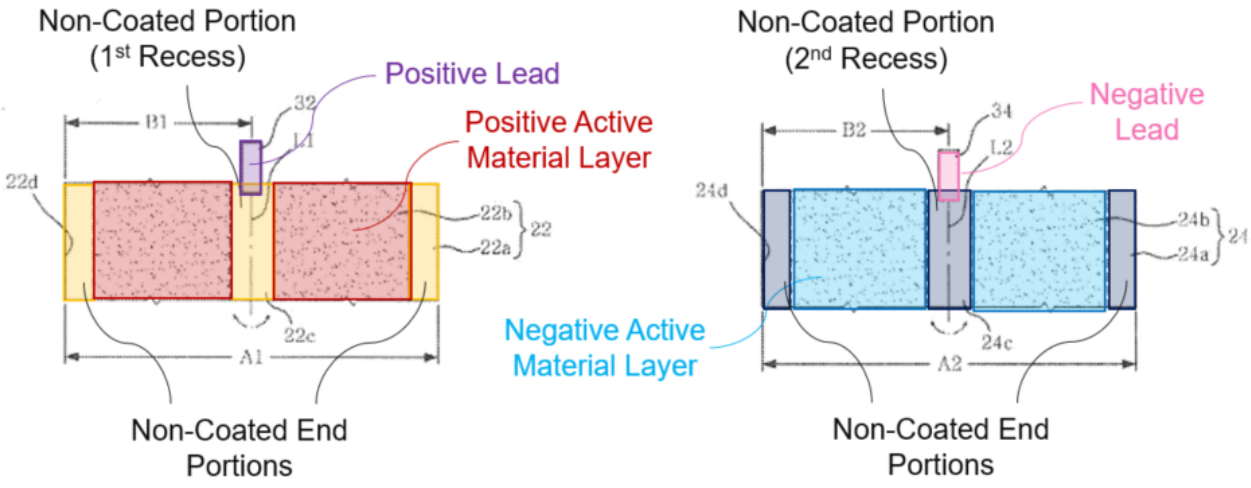
end of the coil.

### D. The combination of Sato, Takemura, Oh-539, and Oh-144 renders obvious claims 20 and 22.

250. Claims 20 and 22 both recite "two insulating layers are disposed on two opposite surfaces of the positive plate, and a winding end of the negative plate is located between the two insulating layers; and the two insulating layers extend over the winding end of the negative plate along the winding direction."

#### 1. Combination of Sato, Takemura, and Oh-539

251. As discussed above in Section XI.C.1, it would have been obvious to use Oh-539's method to make Sato's positive and negative electrodes. This modification would result in Sato's electrodes having the same layout as Oh-539's electrodes, as shown in the following annotated figures.



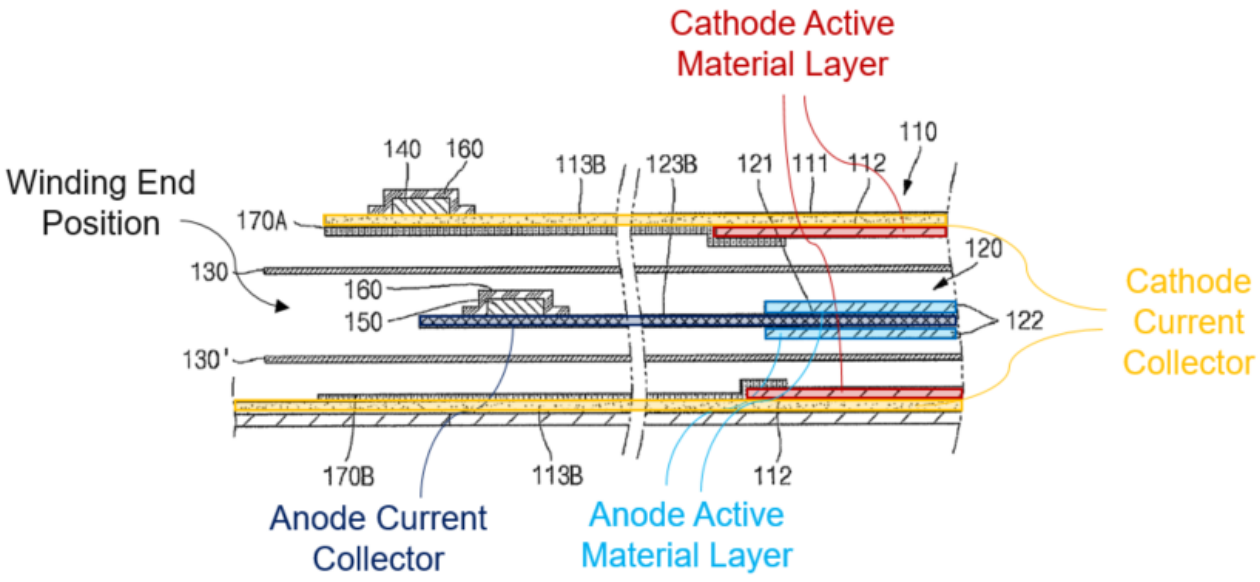

EX1007, FIGs. 2-3 (annotated).

252. The combination of Sato, Takemura, and Oh-539 does not explicitly

disclose two insulating layers disposed on opposite surfaces of the positive plate such that a winding end of the negative plate is located between the two layers and the two layers extend over the winding end. But including these two insulating layers in the Sato-Takemura-Oh-539 battery would have been obvious in view of Oh-144.

**2. Oh-144**

253. Oh-144 discloses two tapes 170A, 170B disposed on the cathode plate 110 at the winding end portion of the anode plate 120. EX1017, ¶¶[0038], [0039]; The first tape 170A covers the bottom (inner side) surface of the uncoated cathode portion 113B above exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0038]. The second tape 170B covers a top (outer side) surface of the uncoated cathode portion 113B below exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0039]. Both of these tapes 170A, 170B are positioned to prevent short circuits that could be caused by contact between exposed metal at the winding end. EX1017, ¶¶[0038]-[0039].




EX1017, FIG. 4 (annotated).

### 3. Sato-Takemura-Oh-539-Oh-144 Combination

254. It would have been obvious to position Oh-144's tapes 170A, 170B on inner and outer surfaces of non-coated end portions of the positive electrode in the Sato-Takemura-Oh-539 battery, as shown above.

255. By positioning Oh-144's tapes 170A, 170B in this manner, and winding the battery coil as illustrated by Oh-144, the two tapes 170A, 170B would be disposed on opposite inner and outer surfaces of the positive plate such that a winding end of the negative plate is located between the two tapes and the two tapes extend over the winding end, as shown above. Applying the tapes 170A, 170B to on opposite surfaces of the positive plate in this manner in the Sato-Takemura-Oh-539 battery would have simply been applying additional tapes at known locations for the known benefit of improving short-circuit resistance.

256. Thus, the combination of Sato, Takemura, Oh-539, and Oh-144 renders claims 20 and 22 obvious.

## XII. GROUND 4: CLAIMS 9-11, 14, and 16 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO IN COMBINATION WITH TAKEMURA AND KOBAYASHI.

### A. U.S. Patent Pub. No. 2011/0111276 to Sato *et al.* (Sato)

257. Sato discloses a lithium-ion battery as I discussed above in Section IX.A.

### B. Japanese Patent Pub. No. JP 2006-067907 to Takemura *et al.* (Takemura)

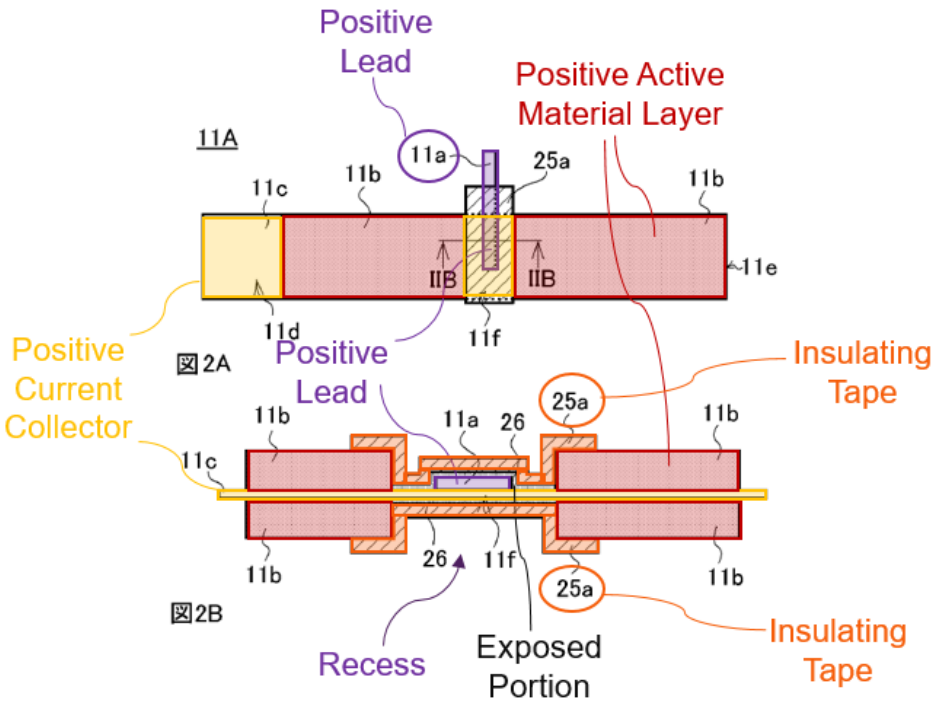
258. Takemura discloses a lithium-ion battery as I discussed above in Section IX.B.

### C. Japanese Patent Pub. No. JP 2010-055906 to Kobayashi *et al.* (Kobayashi)

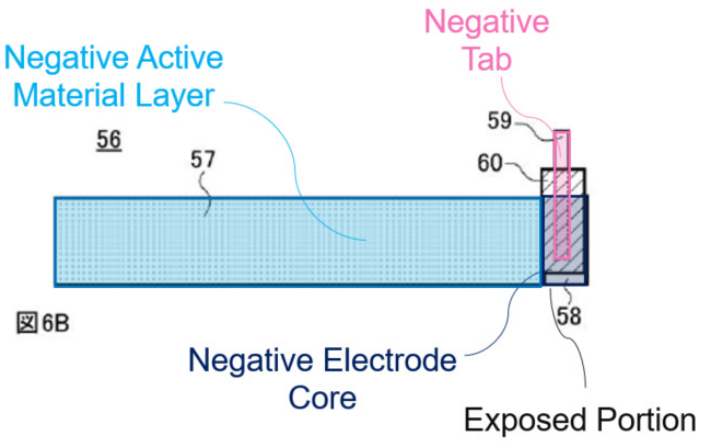
259. Japanese Patent Pub. No. JP 2010-055906 to Kobayashi et al. published on March 11, 2010. Kobayashi's publication date precedes the '498 patent's earliest effective filing date of January 17, 2014, by almost three years.

260. Kobayashi discloses a lithium-ion non-aqueous electrolyte secondary battery having a positive electrode plate 11A with positive electrode core (foil) 11c and a positive electrode active material layer 11b, and a negative electrode plate 56 with a negative electrode core (foil) 58 and a negative electrode active material layer 57. EX1008, ¶[0007], [0013], [0034], [0035], FIGS. 2A-B and 6B. The positive electrode plate 11A has an exposed portion 11f of metal foil and a positive

current collecting tab 11a attached to the exposed portion 11f. EX1008, ¶¶[0013], [0034]. Similarly, the negative electrode plate 56 has an exposed portion 53 of metal foil and a negative current collecting tab 54 attached to the exposed portion 53 of metal foil. EX1008, ¶¶[0007], [0013]. The positive electrode plate 11A and the negative electrode plate 56 are wound together with a separator 13 disposed between them. EX1008, ¶¶[0013], [0028].




EX1008, FIGs. 2A and 2B (annotated).




EX1008, FIG. 6B (annotated).

261. To protect the exposed portion 11f, Kobayashi places tapes 25a on both the top and bottom surface of the exposed portion 11f of the positive electrode plate 11A. EX1008, ¶¶[0034]-[0035] and FIGs. 2A-2B. As shown above in FIGs. 2A and 2B, a first piece of tape 25a is placed on the top surface covering the positive current collecting tab 11a and edges of the positive active material 11b adjacent the positive current collecting tab 11a. EX1008, ¶¶[0034]-[0035]. Similarly, a second piece of tape 25a is placed on the bottom surface covering exposed metal foil opposite the positive current collecting tab 11a and edges of the positive active material 11b on the bottom surface. EX1008, ¶¶[0034]-[0035].

262. Kobayashi's tapes 25a covered the positive current collecting tab 11a and exposed metal foil within the exposed portion 11f to prevent short circuits from occurring at the exposed portion 11f. EX1008, ¶¶[0005], [0010], [0014]. In particular, Kobayashi's tapes 25a are designed to prevent short circuits caused by

pressure points and burrs produced on the step edges of the positive electrode active material layer 11b and the tab attached to exposed portion 11f. EX1008, ¶[0005], [0010], [0014]. "[I]f the edges of the positive electrode active material layer and the negative electrode active material layer are not covered with insulating tape, it is not possible to suppress the occurrence of short circuits caused by the steps at the edges of the positive electrode active material layer and the negative electrode active material layer." EX1008, [0010].

### D. A POSA would have been motivated to combine Sato, Takemura, and Kobayashi with a reasonable expectation of success.

263. For the same reasons discussed above in the motivation to combine section of Ground 1 (Section IX.C), a POSA would have been motivated to combine the teachings of Takemura's insulating tape placement with Sato such that Sato's second insulating tape is located on the positive active material opposite to the negative lead connection. EX1006, ¶¶3, 8, 22; *see also* EX1009, ¶8; EX1010, ¶29; EX1011, ¶[0018]. Furthermore, a POSA would also have had a reasonable expectation of success in combining the teachings of Sato and Takemura. Insulating tapes were common in coiled lithium-ion battery cells well before 2014. *See* EX1006, ¶¶[0003], [0008], [0022]; see also EX1009, ¶[0008]; EX1010, ¶[0029]; EX1011, ¶[0018]. What is more, insulating tapes were specifically known to help prevent lithium plating in coiled lithium-ion batteries. EX1009, ¶[0008], EX1016, ¶[0010]. A POSA would have expected Takemura's insulating tape,

incorporated into Sato's battery, to perform its intended function of insulating exposed metal from chemical interactions capable of producing lithium plating. Combining Takemura's insulating tape with Sato's battery would have amounted to nothing more than applying Takemura's tape to Sato's battery at a known position for a known benefit.

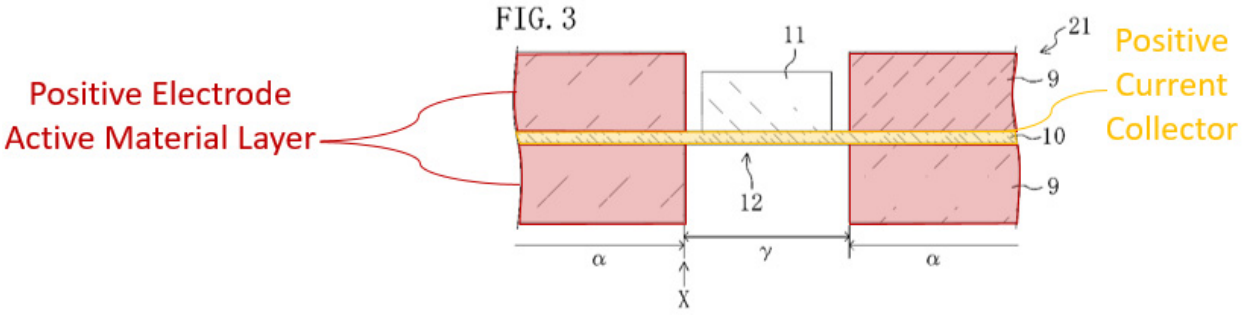
264. A POSA would have also been motivated to combine the teachings of Kobayashi's insulating tape placement to an exposed surface of a current collector opposite to the current collector surface coupled to the positive lead of Sato's battery, as modified by Takemura, for the reasons explained below.

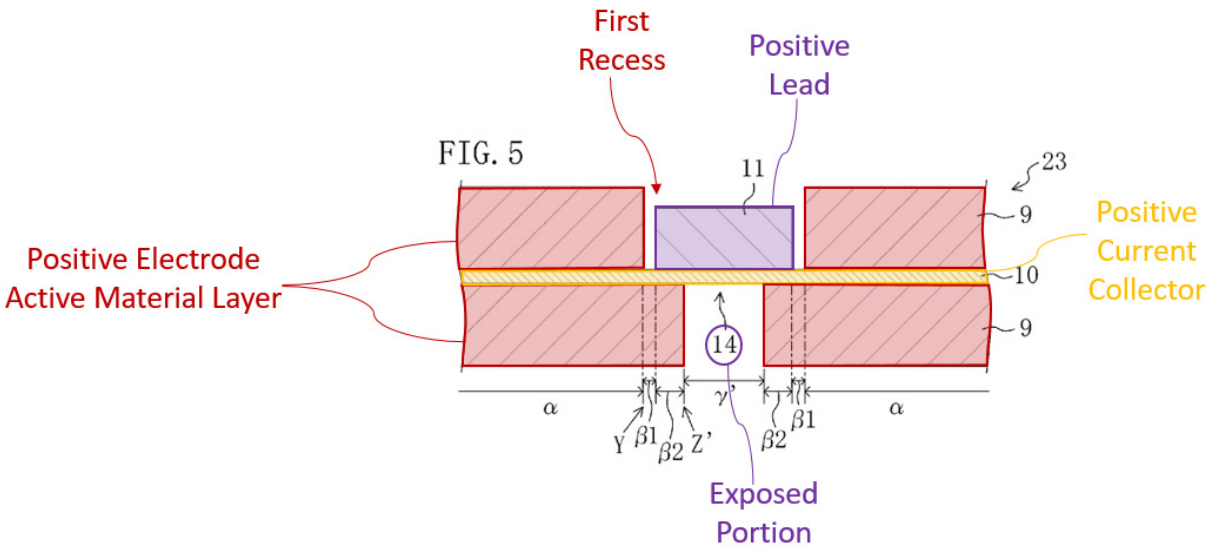
265. Sato, Takemura, and Kobayashi are analogous art as all three disclose coiled lithium-ion battery cells. EX1005, ¶[0001]; EX1006, ¶[0001]; EX1008, ¶¶ [0014]-[0016]. Each of Sato, Takemura, and Kobayashi disclose non-aqueous electrolyte coiled lithium-ion battery cells with insulating tapes configured to enhance reliability and prevent safety hazards within the battery cells. EX1005, ¶¶[0010], [0113]; EX1005, ¶[0003]; EX1008, ¶[0013].

266. Sato discloses insulating tapes configured to protect the positive and negative leads and an additional insulating tape configured to prevent lithium plating. EX1005, ¶[0113], [0120]. Relatedly, Takemura discloses insulating tape configured to cover exposed portions of a negative current collector to prevent short-circuiting caused by lithium plating. EX1006, ¶[0008]. Also relatedly,

Kobayashi discloses insulating tapes configured to overlap exposed metal portions and edges of a positive active material to prevent short-circuiting at the edges of the positive active material. EX1008, ¶[0014].

267. As shown below in Figures 3 and 5, Sato describes exposing a surface (portion 12/14) of positive current collector 4A/10 that is opposite to the surface of the positive current collector 4A/10 connected to positive lead 4L/11. EX1005, ¶¶[0037]-[0040].

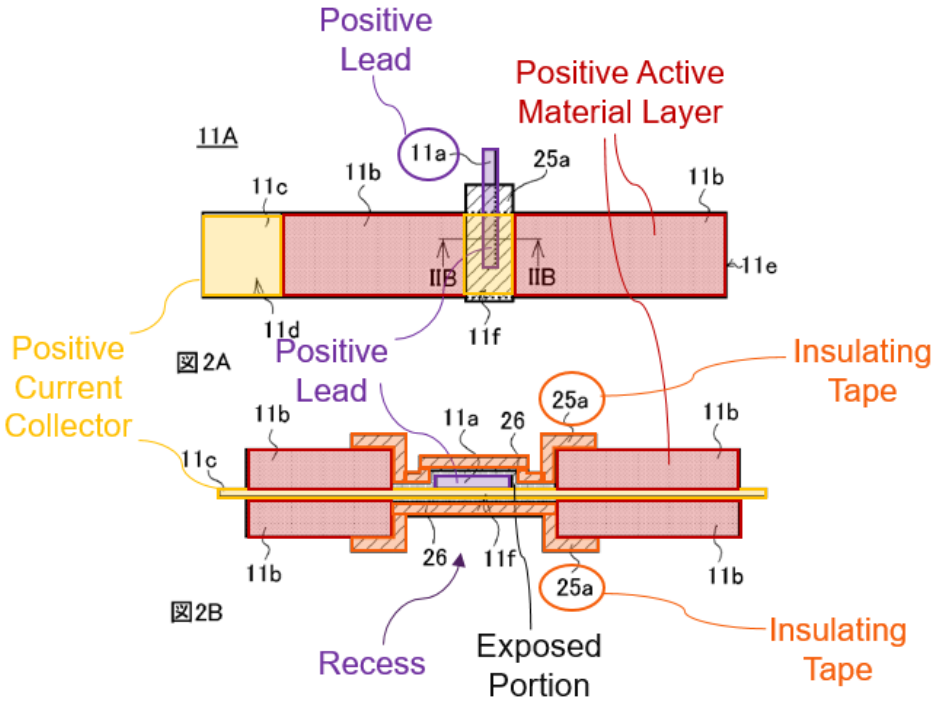


EX1005, FIGs. 3 and 5 (annotated).

268. While Sato describes covering the surface of positive current. collector 4A/10 connected to positive lead 4L/11 with a polypropylene adhesive tape, Sato does not explicitly disclose covering the opposite exposed surface of positive current collector 4A/10 with another polypropylene adhesive tpae. But covering both the surface of positive current collector connected to the positive lead with a first insulating tape and the opposite exposed surface of positive current collector with another first insulating tape was well known, as evidenced by Kobayashi.

269. As shown below in Figures 2A and 2B, Kobayashi discloses tapes 25a on both the top and bottom surface of the exposed portion 11f of the positive electrode plate 11A. EX1008, ¶¶[0034]-[0035]. A first tape 25a is placed on the top surface covering the positive current collecting tab 11a and edges of the positive active material 11b adjacent the positive current collecting tab 11a. EX1008, ¶¶[0034]-[0035]. Similarly, a second tape 25a is placed on the bottom surface covering exposed metal foil opposite the positive current collecting tab 11a and edges of the positive active material 11b on the bottom surface. EX1008, ¶¶[0034]-[0035].




EX1008, FIGs. 2A and 2B (annotated).

270. Kobayashi's tapes 25a cover the positive current collecting tab 11a and exposed metal foil within exposed portion 11f to prevent short circuits at the exposed portion 11f. EX1008, ¶¶[0005], [0010], [0014]. In particular, Kobayashi's tapes 25a are provided to prevent short circuits caused by pressure points and burrs which are likely at coating step edges and where the tab is attached. EX1008, ¶¶[0005] ("Non-aqueous electrolyte secondary batteries using such wound electrode units have a large incidence of short circuits at points … where localized pressurization pressure increases or burrs are likely to occur when forming a wound electrode unit, such as steps (edges) between the regions in which the positive electrode or negative electrode active material layer is formed or not

formed, and where the current collecting tabs are attached."), [0010], [0014]; *see also* EX1005, ¶¶[0022]-[0023].

271. A POSA would have been motivated to cover the exposed portion 12/14 of Sato's positive current collector 4A/10 opposite to the current collector surface connected to positive lead 4L/11 with another first insulating tape, as taught by Kobayashi, to protect the exposed surface from inadvertent contact with the anode, thereby preventing short-circuiting. EX1008, ¶¶[0005], [0010], [0014]. Indeed, Kobayashi describes localized pressure gradients and burrs can occur at stepped coating edges—"the regions in which the positive electrode or negative electrode active material layer is formed or not formed"—leading to short-circuiting. EX1008, ¶¶[0005], [0010]. A POSA would have understood that exposed portion 12/14 of Sato's positive current collector 4A/10 opposite the current collector surface connected to positive lead 4L/11 has such step edges and may have burrs from welding on the lead, therefore being susceptible to short-circuiting. Accordingly, a POSA would have been motivated to include an insulating tape to cover this exposed portion 12/14 of Sato's positive current collector 4A/10, as taught by Kobayashi, to prevent short-circuiting, and thus improve reliability and safety.

272. A POSA would also have had a reasonable expectation of success combining the teachings of Sato and Takemura with Kobayashi. Again, insulating

tapes were common in coiled lithium-ion battery cells well before 2014. See EX1006, ¶¶3, 8, 22; see also EX1009, ¶8; EX1010, ¶29; EX1011, ¶18. What is more, insulating tapes were specifically known to help prevent short-circuiting at the leads in coiled lithium-ion batteries. EX1011, ¶¶[0014], [0033]-[0034]; EX1012, ¶¶[0037]-[0038]; EX1017, ¶¶[0037]-[0038]. A POSA would have expected Kobayashi's insulating tape, incorporated into the Sato-Takemura battery to perform its intended function of insulating the positive lead, exposed metal, and the edges of the positive active material to prevent short-circuiting. Combining Kobayashi's insulating tape with the Sato-Takemura battery would have amounted to nothing more than applying a known technique (placing Kobayashi's tape to at a known position) to a known device (Sato-Takemura's battery) to yield the predictable result of preventing short-circuiting.

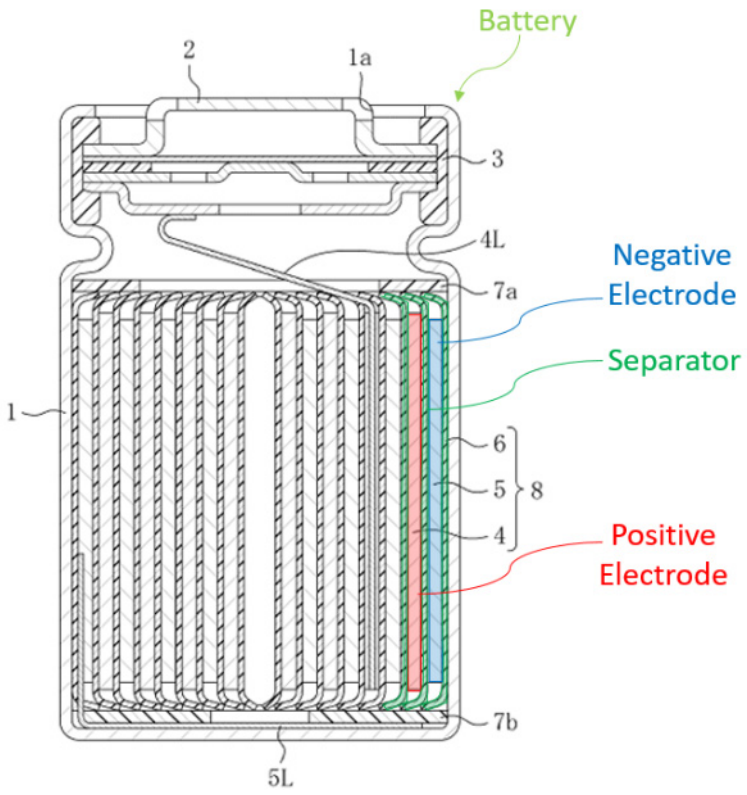
### E. The combination of Sato, Takemura, and Kobayashi discloses or renders obvious every element of claims 9-11 and 16

273. The following explains how each claimed element of the '498 patent is disclosed by Sato, Takemura, and/or Kobayashi. In view of Sato's, Takemura's, and Kobayashi's disclosures, a POSA would have modified Sato in view of Takemura and Kobayashi to arrive lithium-ion batteries as claimed in the '498 patent.

#### 1. [9.P] A lithium-ion battery, comprising:

274. For the same reasons discussed above with respect to Element [1.P],

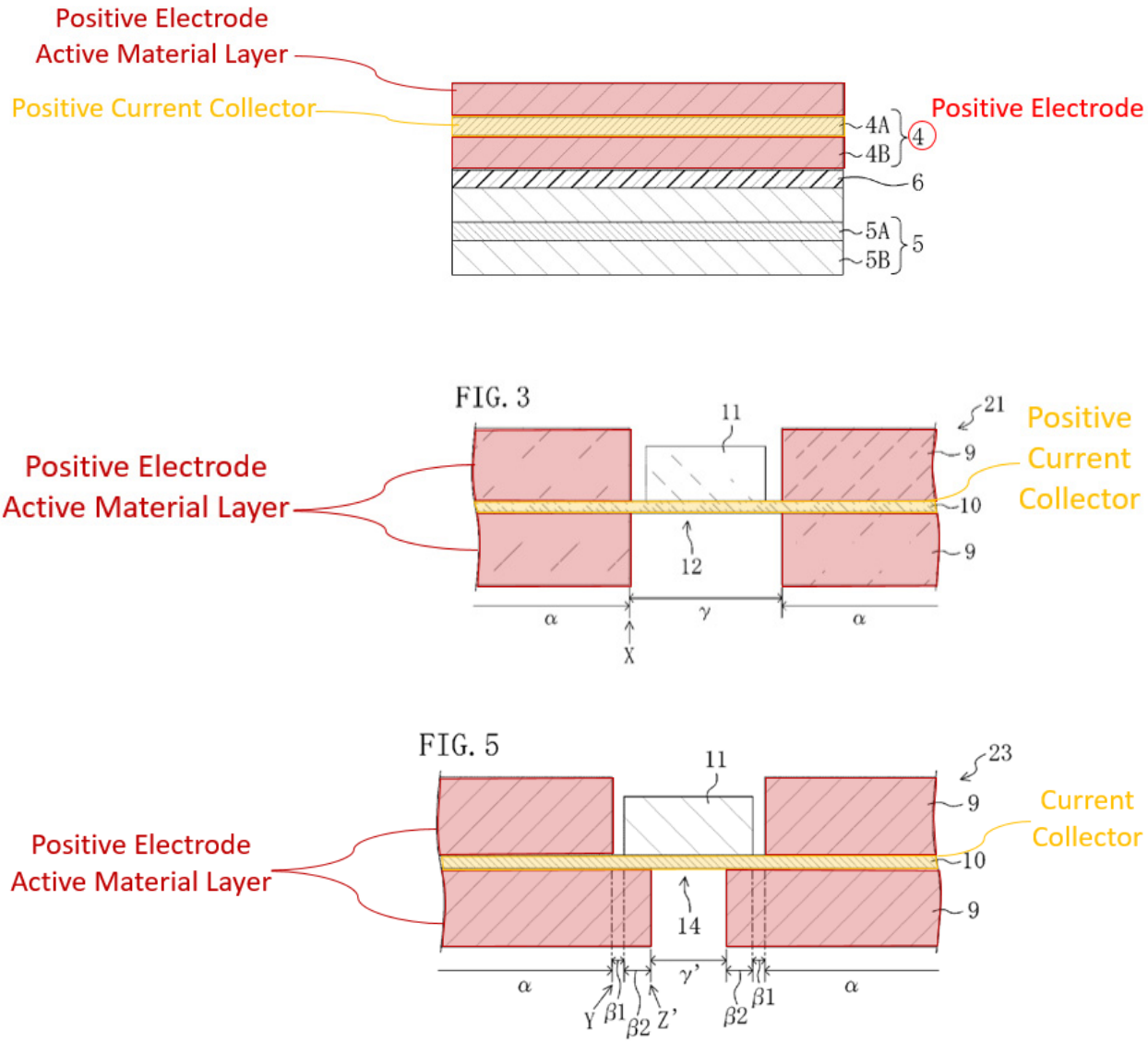
Sato discloses a lithium-ion battery. *See supra* section IX.D.1. As I discussed above in Section IX.D.1, Sato discloses that (i) the positive electrode (for example, the positive electrode of Battery 1) can have a recess for accommodating a positive lead, (ii) the negative electrode (for example, the negative electrode of Battery 8) can have a recess for accommodating the negative lead, or (iii) both the positive electrode and the negative electrode can have a recess for accommodating the positive lead and the negative lead, respectively. EX1005, ¶[0094] (explaining that both leads 4 and 5 can be attached to the electrodes at a location ranging from ¼ to ¾ the length of the electrode). Accordingly, POSA would have understood that Sato discloses a lithium-ion battery. And more specifically, a POSA would have understood that Sato discloses a lithium-ion battery with positive and negative electrodes each having a recess for accommodating the respective lead.




EX1005, FIG. 1 (annotated).

**2. [9.A] "a positive electrode, comprising a positive current collector and a positive electrode active material layer being formed on the positive current collector."**

275. For the same reasons discussed above with respect to Element [1.A], Sato discloses the recited "positive electrode" in the form of positive electrode plate 4, the recited "positive current collector" in the form of a positive electrode current collector 4A/10, and the recited "positive electrode active material layer" in the form of electrode material mixture layer 4B/9. *See supra* section IX.D.2; EX1005, ¶¶[0030], [0033], [0039].

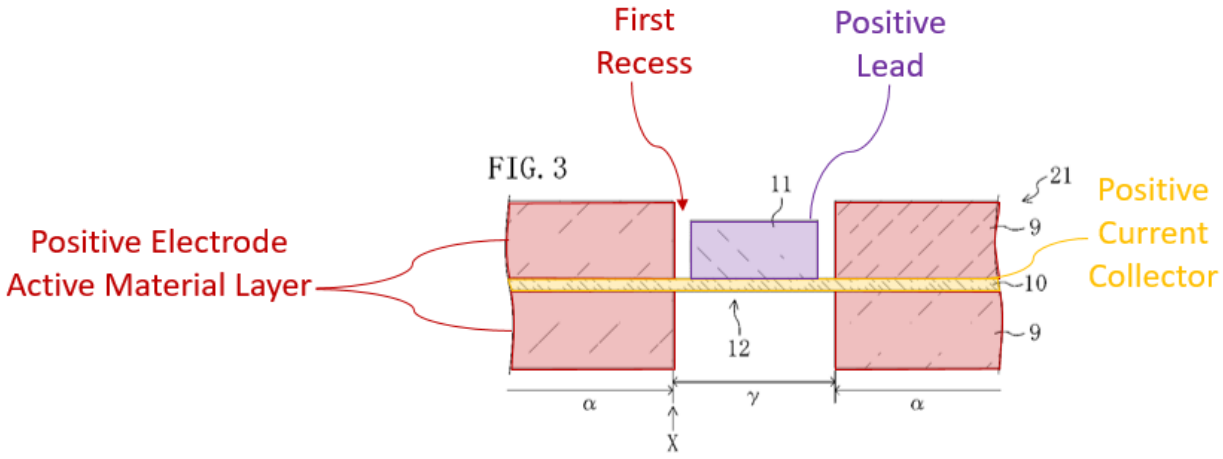



EX1005, FIGs. 2, 3, and 5 (annotated).

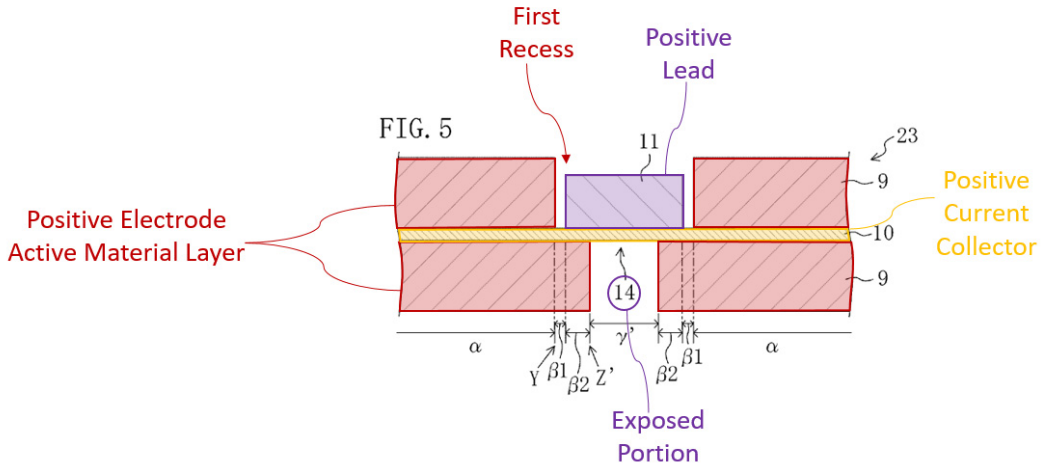
### 3. [9.B] "the positive electrode active material layer being provided with a first recess accommodating a positive lead being coupled with the positive current collector"

276. For the same reasons discussed above with respect to Element [1.B], Sato discloses providing the positive active material layer (4B/9) with a first recess in the form of an exposed portion 12/14 defined where "the mixture layer 9 is not

formed on each of both surfaces of the current collector 10." EX1005, ¶¶39, 111. Sato discloses coupling a positive lead with the positive current collector in the form of an extension lead 11 "connected to one of the surfaces of the exposed portion 12" of current collector 10. *See supra* section IX.D.3; EX1005, ¶¶[0039], [0093].



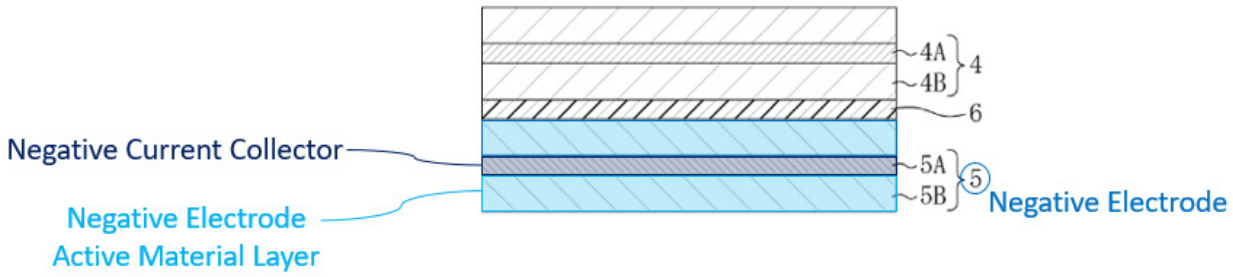

EX1005, FIG. 3 (annotated).

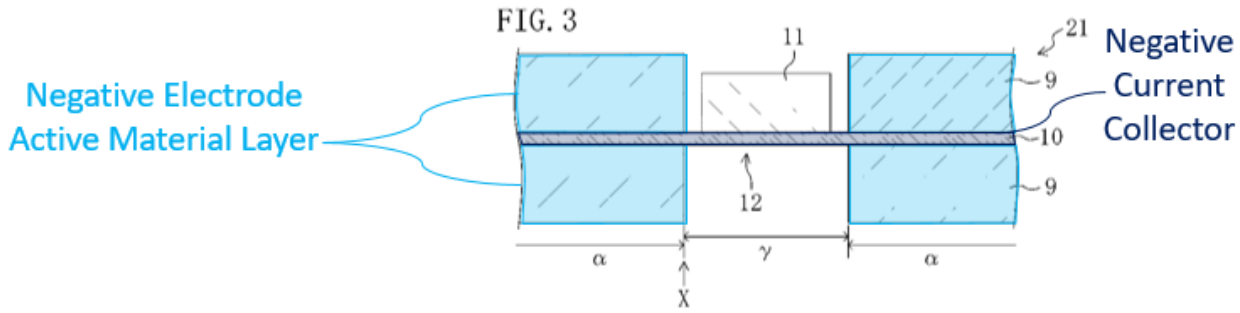


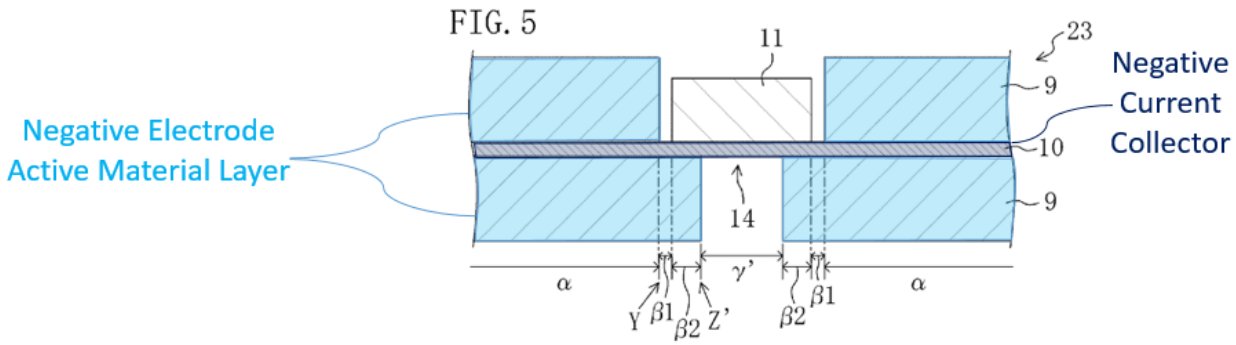

EX1005, FIG. 5 (annotated).

**4. [9.C] "a negative electrode, comprising a negative current collector and a negative electrode active material layer being formed on the negative current collector"**

277. For the same reasons discussed above with respect to Element [1.C], Sato discloses the recited "negative electrode" in the form of a negative electrode plate 5, the recited "negative current collector" in the form of a negative electrode current collector 5A/10, and the recited "negative electrode active material layer" in the form of a negative electrode material mixture layer 5B/9. *See supra* section IX.D.4; EX1005, ¶¶[0034], [0039].



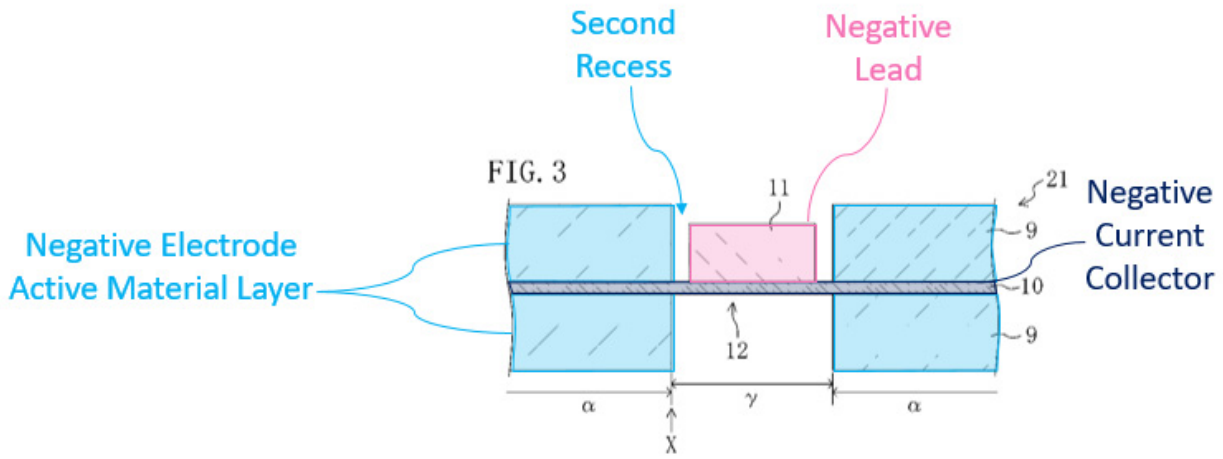





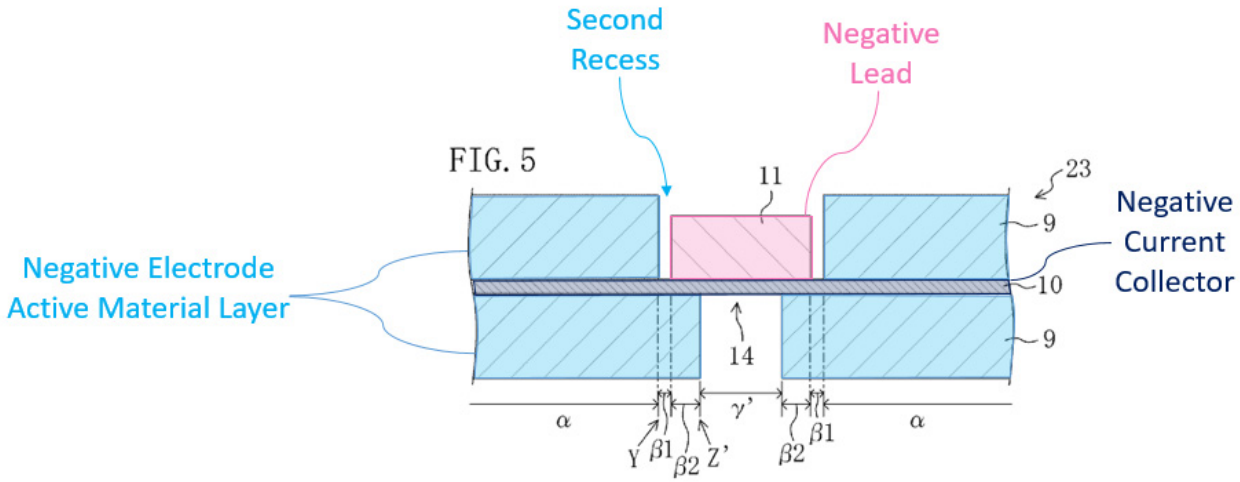

EX1005, FIGs. 2, 3, and 5 (annotated).

**5. [9.D] "the negative electrode active material layer being provided with a second recess accommodating a negative lead being coupled with the negative current collector;"**

278. For the same reasons discussed above with respect to Element [1.D], Sato discloses providing the negative active material layer (5B/9) with a second recess in the form of an exposed portion 12/14 defined where "the mixture layer 9 is not formed on each of both surfaces of the current collector 10." EX1005, ¶¶39, 137. Sato discloses coupling a negative lead with the negative current collector in the form of an extension lead 11 "connected to one of the surfaces of the exposed portion 12" of current collector 10. *See supra* section IX.D.5; EX1005, ¶¶[0039], [0093].



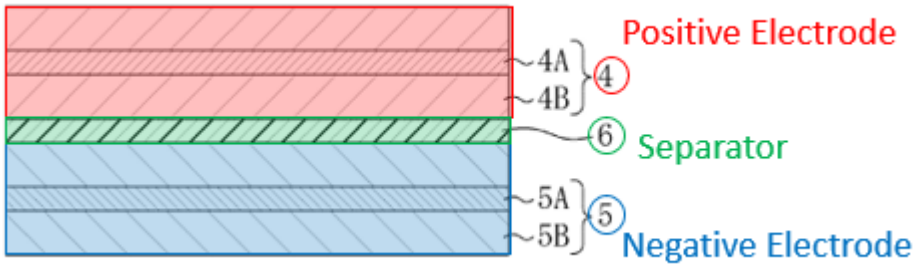

EX1005, FIG. 3 (annotated).



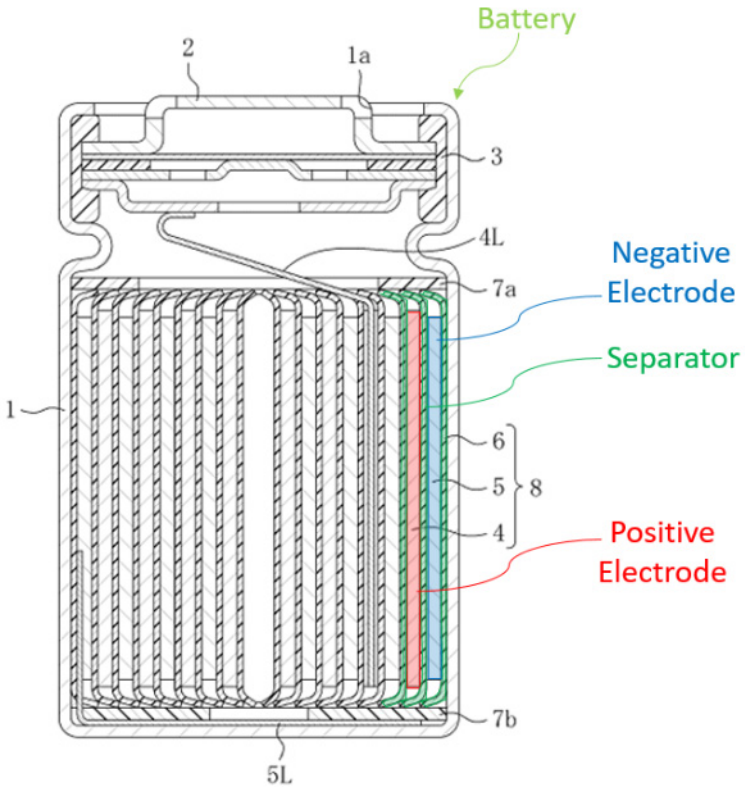

EX1005, FIG. 5 (annotated).

**6. [9.E] "a separator disposed between the positive electrode and the negative electrode"**

279. For the same reasons discussed above with respect to Element [1.E], Sato discloses the recited "separator" in the form of "a porous insulating layer (i.e., a separator) 6" interposed between positive electrode plate 4 and negative electrode plate 5. *See supra* section IX.D.6; EX1005, ¶¶[0030], [0113].




EX1005, FIG. 2 (annotated).




EX1005, FIG. 1 (annotated).

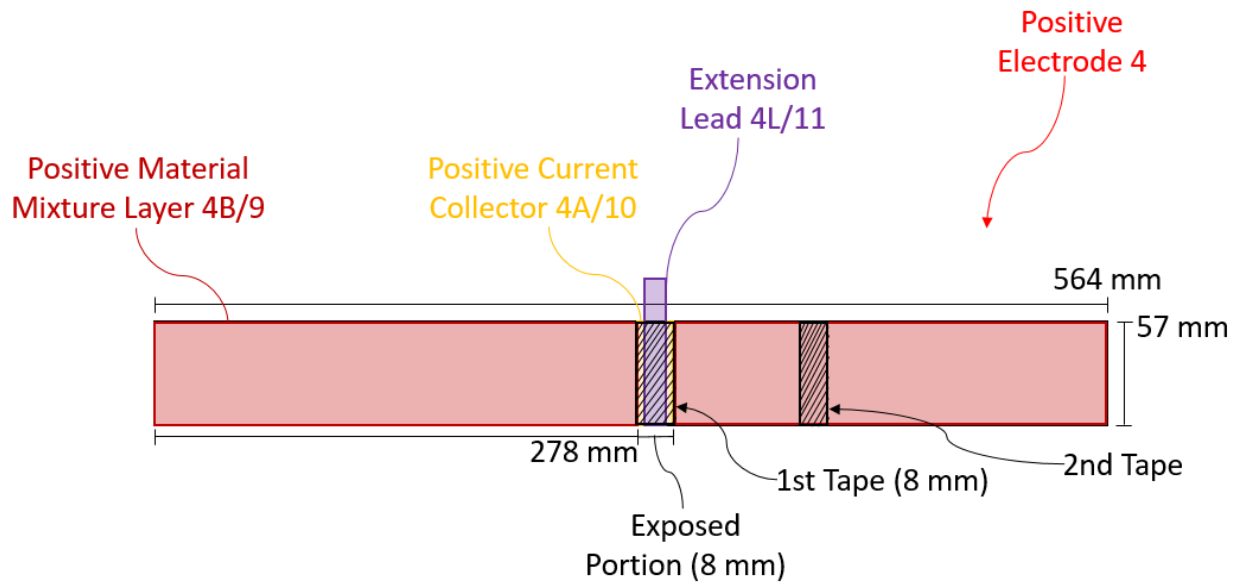
**7. [9.F] "an electrolyte,"**

280. For the same reasons discussed above with respect to Element [1.F], Sato discloses the recited "electrolyte" in the form of a "nonaqueous electrolyte," such as "nonaqueous electrolyte, a gelled nonaqueous electrolyte, or a solid

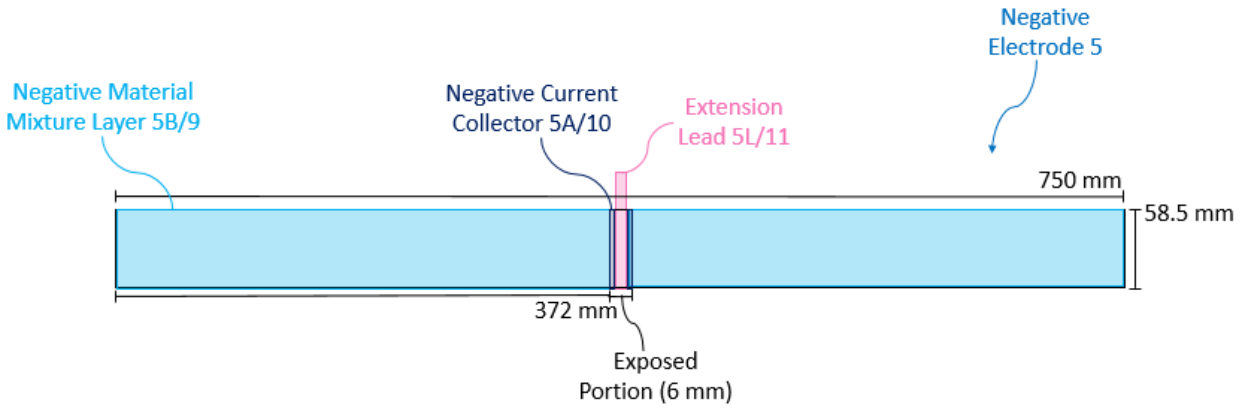
nonaqueous electrolyte." *See supra* section IX.D.7; EX1005, ¶¶[0028], [0074].

**8. [9.G] "wherein, a first location of a top surface of the positive lead is provided with a first insulating glue layer,"**

281. For the same reasons discussed above with respect to Element [1.G], Sato discloses providing a top surface of the positive lead with a polypropylene adhesive tape. *See supra* section IX.D.8; EX1005, ¶[0113] ("[L]eads…protected and insulated by a polypropylene adhesive tape with a width of 8 mm in the positive electrode plate and by a polyethylene adhesive tape in the negative electrode plate."). It is my understanding that Patent Owner equates adhesive tape to an insulating glue layer in the related district court complaint. EX1024, 8, 27, 28. Under Patent Owner's position, Sato's polypropylene adhesive tape is an insulating glue layer. Furthermore, a POSA would have understood that Sato's polypropylene adhesive tape is located on top of the positive lead 4L/11 to "protect[] and insulate[]" all the exposed portions of positive lead 4L/11 from the negative electrode, as shown below.




Sato's Positive Electrode.

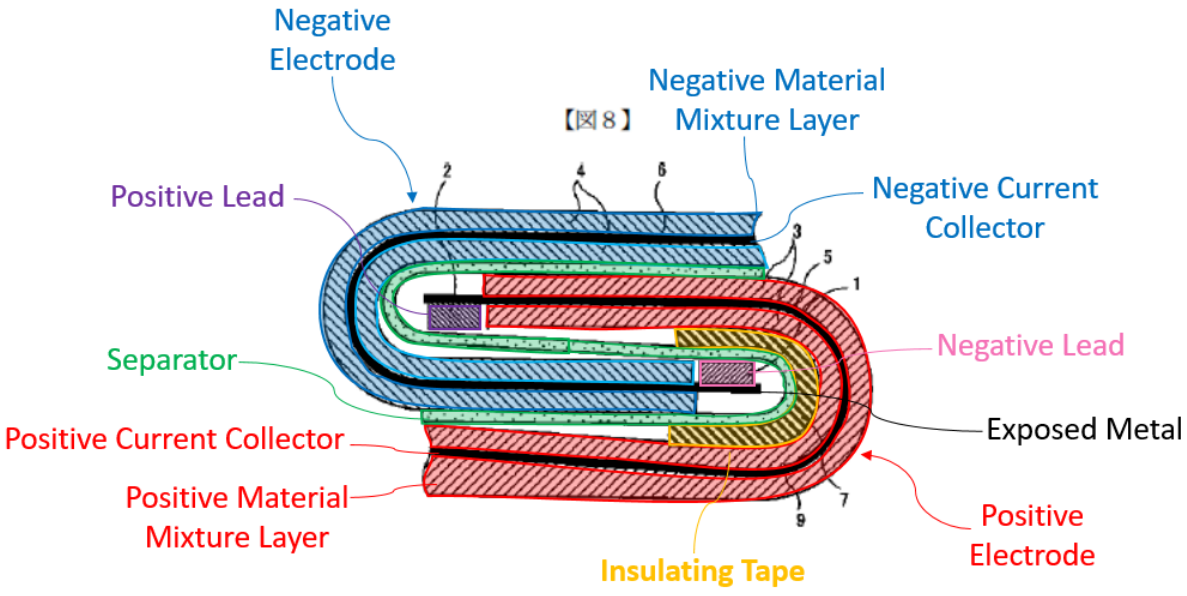



Sato's Negative Electrode.

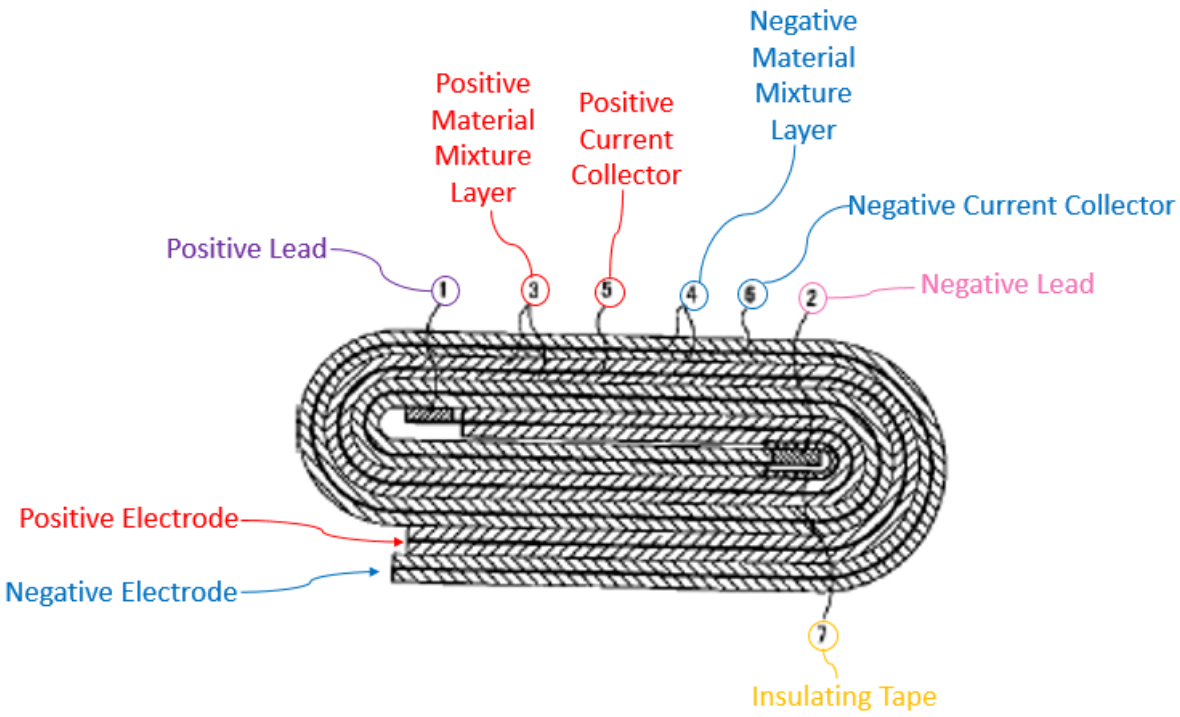
**9. [9.H] "a second location of a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer,"**

282. For the same reasons discussed above with respect to Element [1.H], the Sato-Takemura combination renders obvious locating an additional polypropylene adhesive tape at a second location of a surface of the positive

electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate. *See supra* section IX.D.9; EX1006, ¶¶[0003], [0008]. Specifically, Takemura locates an insulating tape 7 on the positive electrode's active material 3 across a separator 8 opposite a negative lead 2. EX1006, ¶[0003], FIGs. 8-9. In Figures 8-9, reproduced below, Takemura's insulating tape 7 is attached to positive active material 3 adjacent to separator 8 and across from a bare negative electrode current collector 6 where negative lead 1 is attached. It would have been obvious to apply Sato's additional polypropylene adhesive tape to "a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate," as taught by Takemura, to prevent lithium plating.




EX1006, FIG. 8 (annotated).




EX1006, FIG. 9 (annotated).

**10. [9.I.1] "a third location of a surface of the positive current collector opposite to the surface of the positive current collector where the positive lead is covered with another first insulating glue layer,"**

**a. Sato**

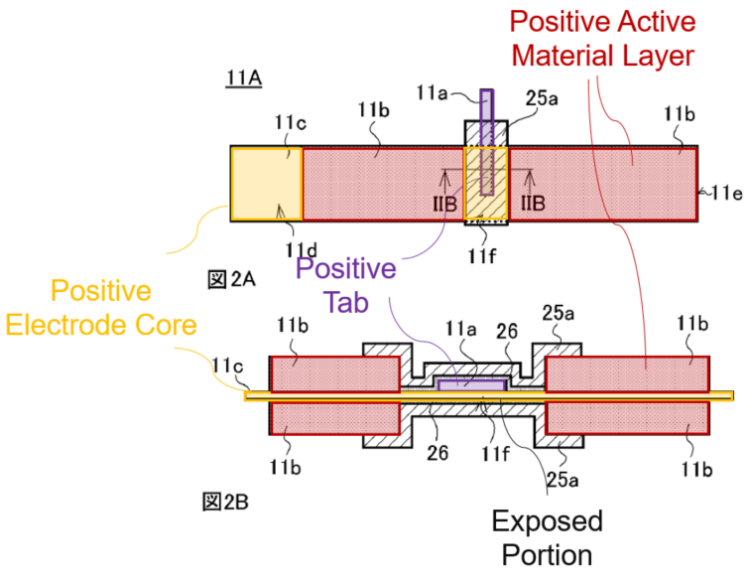
283. As I discussed above with respect to Element [1.H], Sato discloses applying an additional polypropylene adhesive tape on to the positive active material of positive electrode 4 that is opposite to negative electrode lead 5L/11. EX1005, ¶[0137] ("The positive electrode surface facing the negative electrode lead position was insulated by a polypropylene adhesive tape in order to prevent lithium deposition.").

284. While Sato describes providing the additional polypropylene adhesive

tape on a portion of the positive current collector opposite to the negative lead, Sato does not explicitly disclose covering a portion of a second surface, opposite the first surface, on the positive current collector (a third location) with another first insulating tape. But covering a portion of a second surface, opposite the first surface, on the positive current collector at a location opposite to the positive lead would have been obvious in view of Kobayashi.

**b. Kobayashi**

285. As shown below in Figures 2A and 2B, Kobayashi discloses tapes 25a on both the top and bottom surface of the exposed portion 11f of the positive electrode plate 11A. EX1008, ¶¶ [0034]-[0035]. A first piece of tape 25a is placed on the top surface covering the positive current collecting tab 11a and edges of the positive active material 11b adjacent the positive current collecting tab 11a. EX1008, ¶¶ [0034]-[0035]. Similarly, a second piece of tape 25a is placed on the bottom surface covering exposed metal foil opposite the positive current collecting tab 11a and edges of the positive active material 11b on the bottom surface. EX1008, ¶¶ [0034]-[0035].



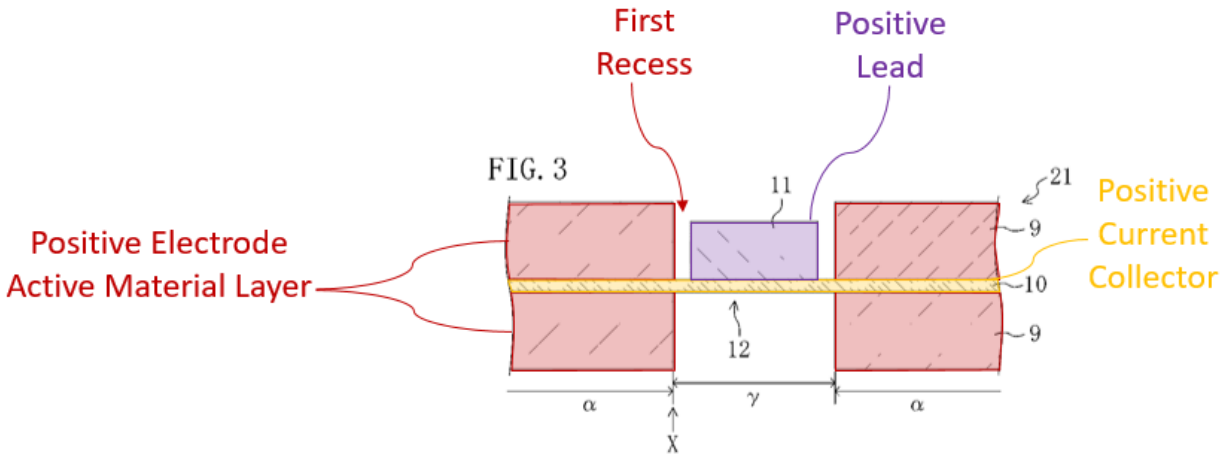

EX1008, FIGs. 2A and 2B (annotated).

286. Kobayashi's tapes 25a covered the positive current collecting tab 11a and exposed metal foil within exposed portion 11f to prevent short circuits from occurring at the exposed portion 11f. EX1008, ¶[0005], [0010], [0014]. In particular, Kobayashi's tapes 25a are designed to prevent short circuits caused by pressure points and burrs which are likely at coating step edges and where the tab is attached. EX1008, ¶[0005], [0010], [0014].

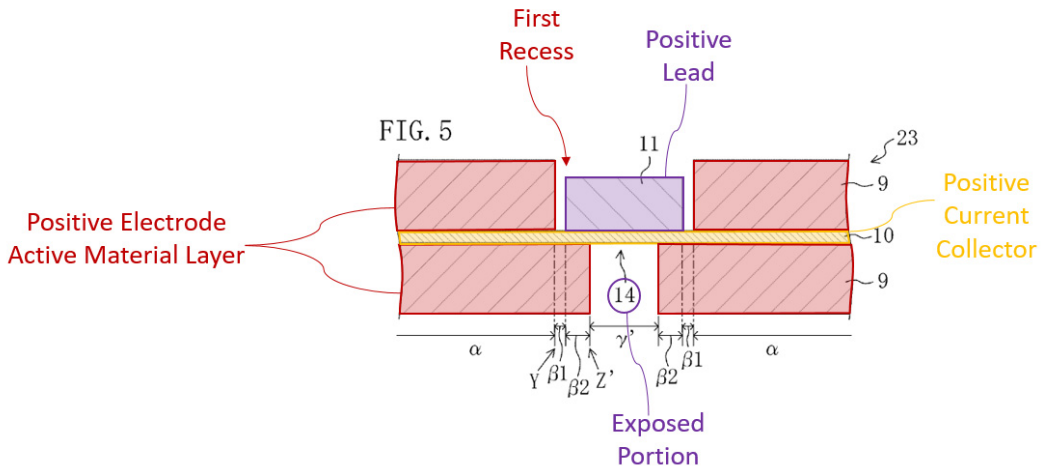
**c. Combination of Sato, Takemura, and Kobayashi**

287. In view of Sato's and Takemura's disclosures, it would have been obvious to a POSA to apply Kobayashi's second piece of tape 25a on the bottom of Sato's positive current collector (4A/10) to cover exposed metal opposite Sato's positive lead 11 and edges of Sato's positive active material (5B/9) on the bottom side of the positive current collector (4A/10).

288. As discussed above with respect to Element [1.B], both sides of Sato's positive current collector (4A/10) are coated with the positive active material layer (4B/9). EX1005, ¶¶[0039], [0041], [0111]-[0113], and FIGs. 3, 5.




EX1005, FIG. 3 (annotated).




EX1005, FIG. 5 (annotated).

289. Based on at least Kobayashi's disclosure, a POSA would have understood that the exposed metal and edges of positive active material on both the top side and bottom side of Sato's positive current collector are susceptible short-

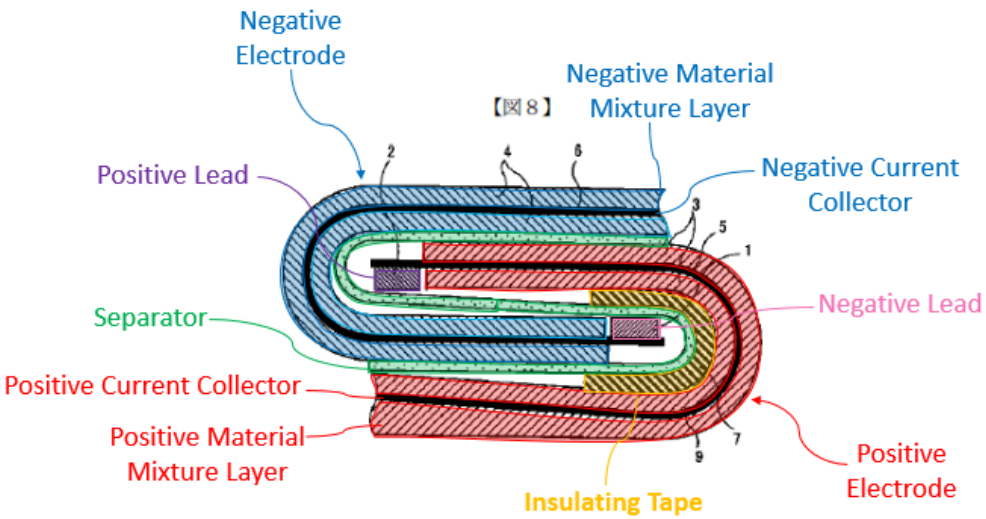
circuiting due to pressure points and burrs. EX1008, ¶¶[0005], [0014]. To prevent any potential short-circuiting pressure points and burrs, a POSA would have been motivated to apply Kobayashi's tape 25a to the bottom side of Sato's positive current collector (4A/10). This modification would have amounted to nothing more than applying a known technique (placing an additional tape at a known location) to a known device (the Sato-Takemura battery) to yield the predictable result of improving reliability and safety.

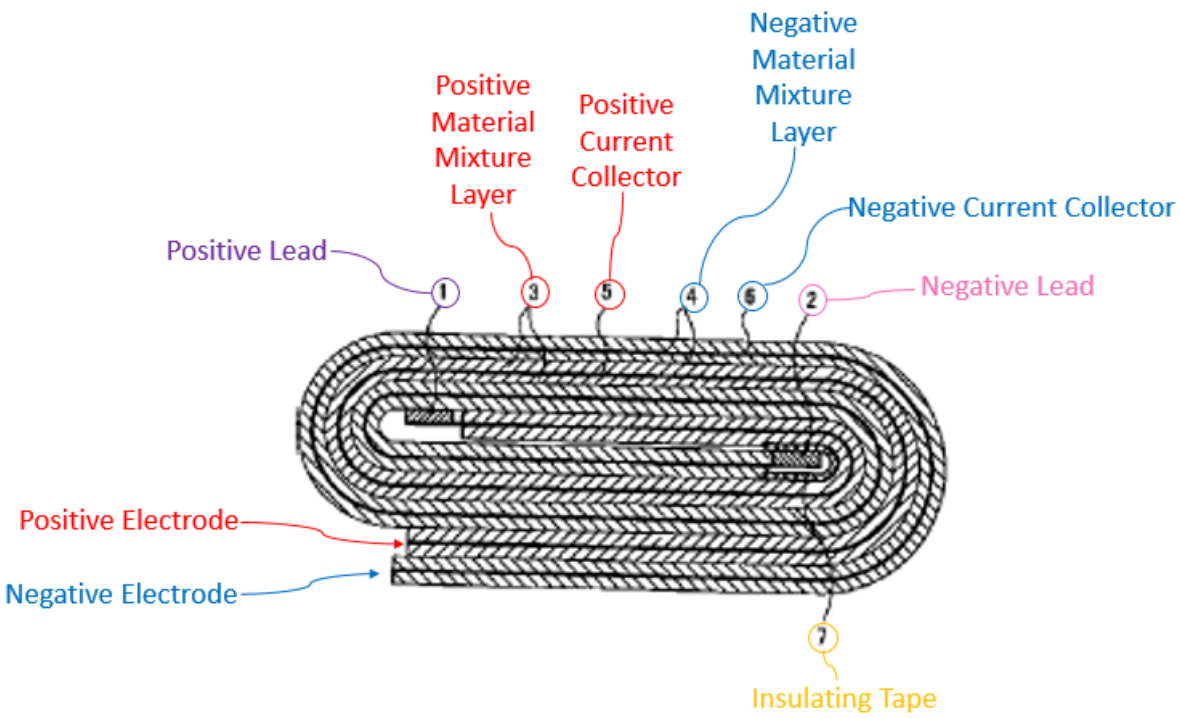
290. Accordingly, the combined disclosures of Sato, Takemura, and Kobayashi render element [9.I.1] obvious.

**11. [9.I.2] "the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of the second recess."**

291. For the same reasons discussed above with respect to Element [1.I], the Sato-Takemura combination renders obvious the second insulating tape having a width larger than a width of the second recess and a length larger than a length of the second recess. *See supra* section IX.D.10. Specifically, in Figures 8-9, Takemura's insulating tape 7 is sized such that it overlaps (i) *all* the exposed metal on the negative current collector 6 and (ii) the edge of the negative active material 4 above and below the negative lead 2, to insulate exposed metal and prevent lithium plating. EX1006, ¶[0008]. Thus, Takemura's insulating tape has a width (measured along the length of the negative electrode cross-section in Figures 8-9)

larger than the exposed metal on the negative electrode current collector. Although Takemura does not illustrate that the insulating tape has a length larger than the length of the exposed metal on the negative electrode current collector, a POSA would have found it obvious to minimize exposing the negative electrode metal to lithium ions released from the positive active material. EX1022, 51. Sizing Sato's additional polypropylene adhesive tape to have a width and length larger than the width and length of the exposed metal in the exposed portion 12/14 would have been necessary to ensure that metal in the exposed portion 12/14 is not exposed to lithium plating as a result of alignment variances. For at least these reasons, having a larger width and length for Sato's additional polypropylene adhesive tape would have amounted to nothing more than sizing the additional tape according to known principles for a known benefit identified by both Sato and Takemura.

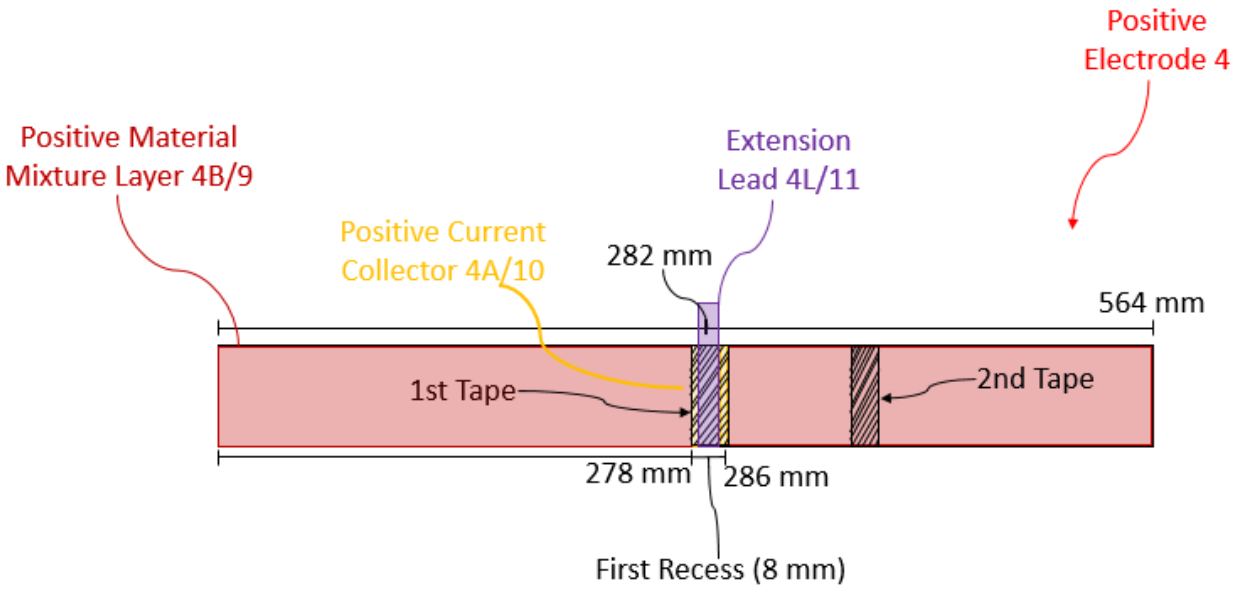





EX1006, FIGs. 8, 9 (annotated).

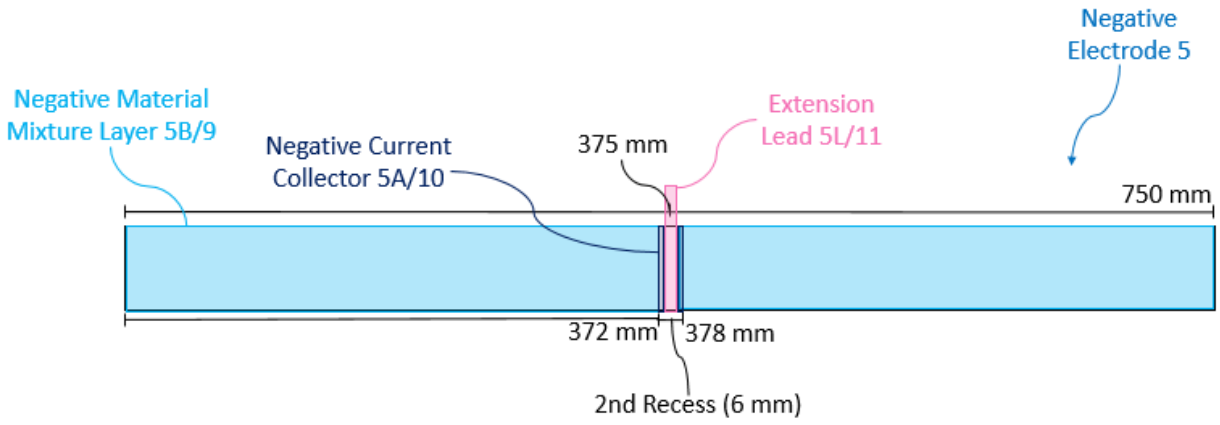
**12. 10. "The lithium-ion battery of claim 9, wherein a distance between a center of the first recess and one end of the positive electrode active material layer is ¼-¾ of a length of the positive electrode active material layer, and a distance between a center of the second recess and one end of the negative electrode active material layer is ¼-¾ of a length of the negative electrode active material layer."**

292. For the same reasons discussed above with respect to claim 2, Sato discloses a distance between a center of the first recess and one end of the positive electrode active material layer is ¼-¾ of a length of the positive electrode active material layer in the form of locating the center of the exposed portion of Sato's positive current collector 4A/10 at 50% ( $\frac{282\ mm}{564\ mm}$ ) of the length of Sato's positive electrode. *See supra* Section IX.D.11; EX1005, ¶[0111].




Sato, Positive Electrode.

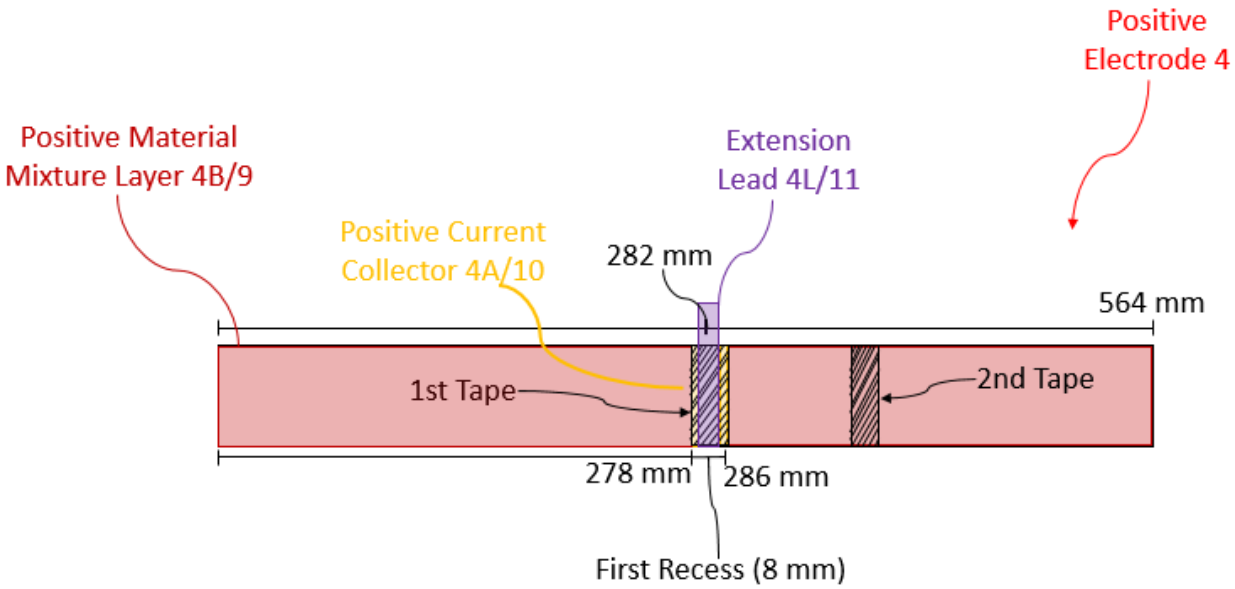
293. Additionally, for the same reasons discussed above with respect to claim 2, Sato discloses a distance between a center of the second recess and one end of the negative electrode active material layer is ¼-¾ of a length of the negative electrode active material layer in the form of locating the center of the exposed portion of Sato's negative current collector 5A/10 at 50% ( $\frac{375\ mm}{750\ mm}$ ) of the length of Sato's negative electrode. *See supra* Section IX.D.11; EX1005, ¶[0137].



Sato, Negative Electrode.

13. **11. "The lithium-ion battery of claim 9, wherein a distance between a center of the first recess and one end of the positive electrode active material layer is half of a length of the positive electrode active material layer, and a distance between a center of the second recess and one end of the negative electrode active material layer is half of a length of the negative electrode active material layer."**

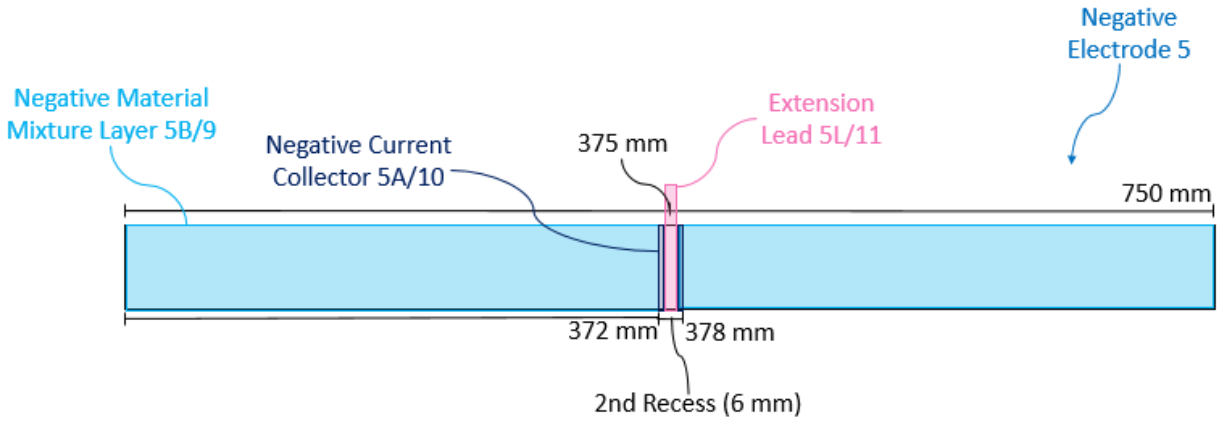
294. For the same reasons discussed above with respect to claim 3, Sato discloses a distance between a center of the first recess and one end of the positive electrode active material layer is half of a length of the positive electrode active material layer in the form of locating the center of the exposed portion of Sato's positive current collector 4A/10 at 50% ( $\frac{282\ mm}{564\ mm}$ ) of the length of Sato's positive electrode. *See supra* Section IX.D.12; EX1005, ¶[0111].




Sato, Positive Electrode.

295. Additionally, for the same reasons discussed above with respect to

claim 3, Sato discloses a distance between a center of the second recess and one end of the negative electrode active material layer is half of a length of the negative electrode active material layer in the form of locating the center of the exposed portion of Sato's negative current collector 5A/10 at 50% ( $\frac{375\ mm}{750\ mm}$ ) of the length of Sato's negative electrode. *See supra* Section IX.D.; EX1005, ¶[0137].

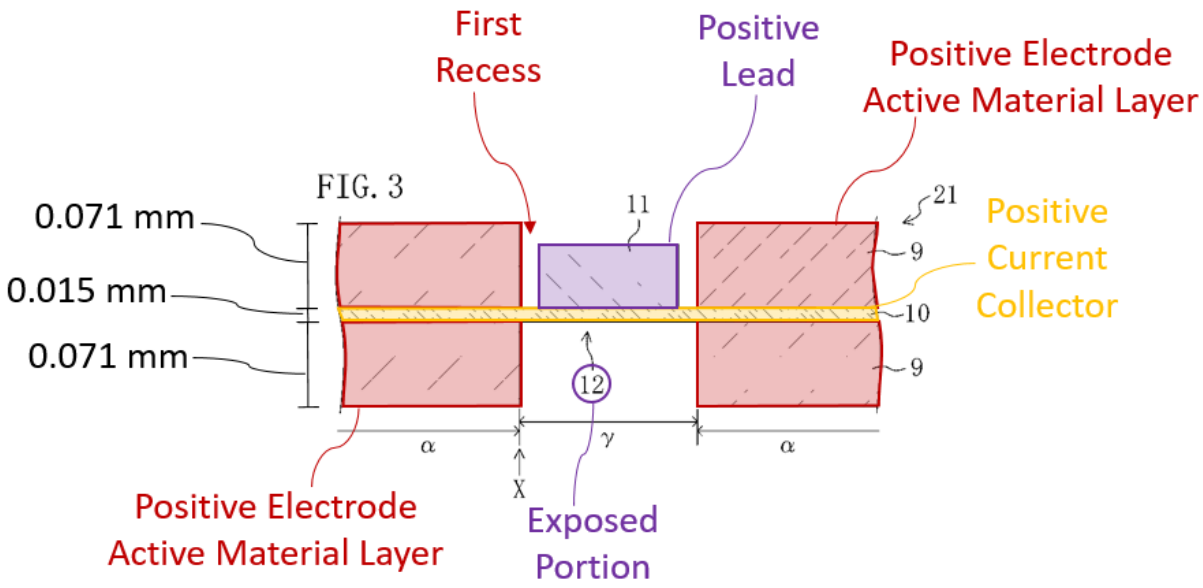



Sato, Negative Electrode.

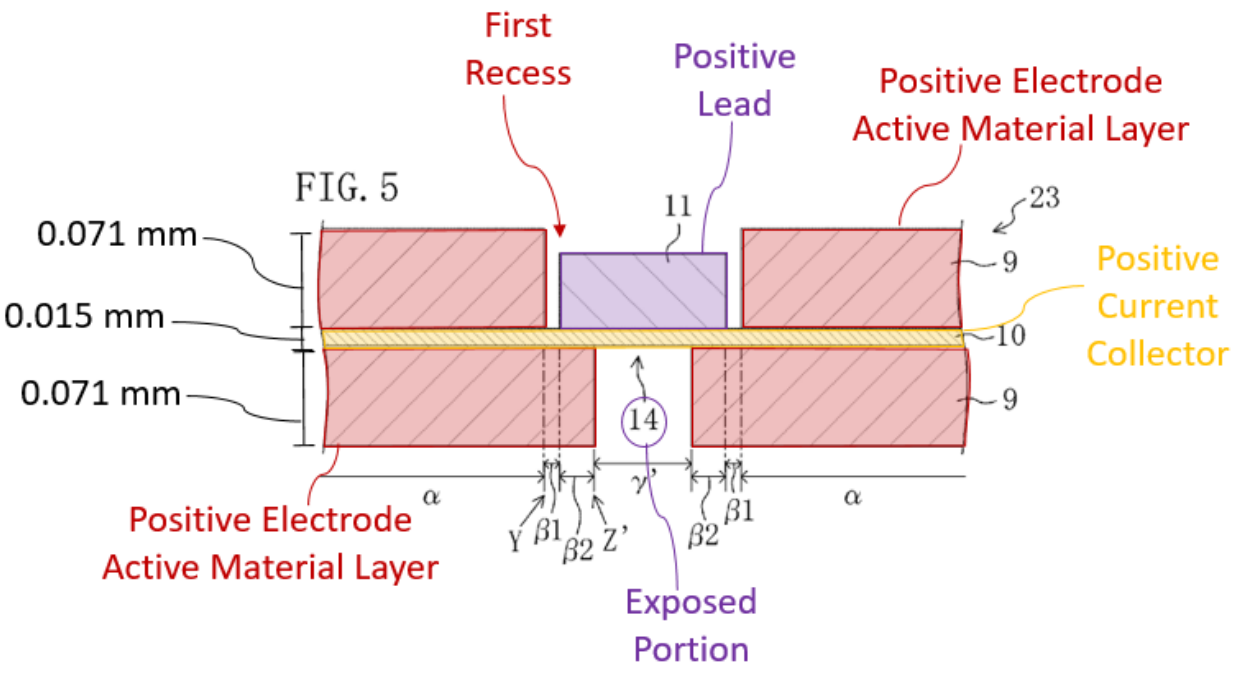
**14. 14. "wherein the first recess has a depth of 0.005-0.1 mm larger than a thickness of the positive lead, and the second recess has a depth of 0.005-0.1 mm larger than a thickness of the negative lead."**

296. For one example battery (Battery 1), Sato discloses "a positive electrode plate having a thickness of 0.157 mm" (i.e., a thickness of 157 μm). EX1005, ¶[0104]. Sato's positive electrode plate includes an aluminum foil current collector "with a thickness of 15 μm." EX1005, ¶[0104]. A POSA would have understood that the thickness of each positive electrode active material layer applied on the surface of the positive current collector is 0.071 mm

($\frac{0.157\ mm - 0.015\ \mu m}{2}$). A POSA would have further understood that the depth of Sato's exposed portion corresponds to the thickness of the active material layer. Sato further describes connecting a "positive electrode lead (with a width of 6 mm)" to the exposed portion (i.e., the first recess) of Sato's positive electrode. EX1005, ¶[0112]. In view of Figures 3 and 5, reproduced below, a POSA would have understood that Sato's first recess (annotated) has a depth of 0.005-0.071 mm larger than the thickness of positive lead (11).



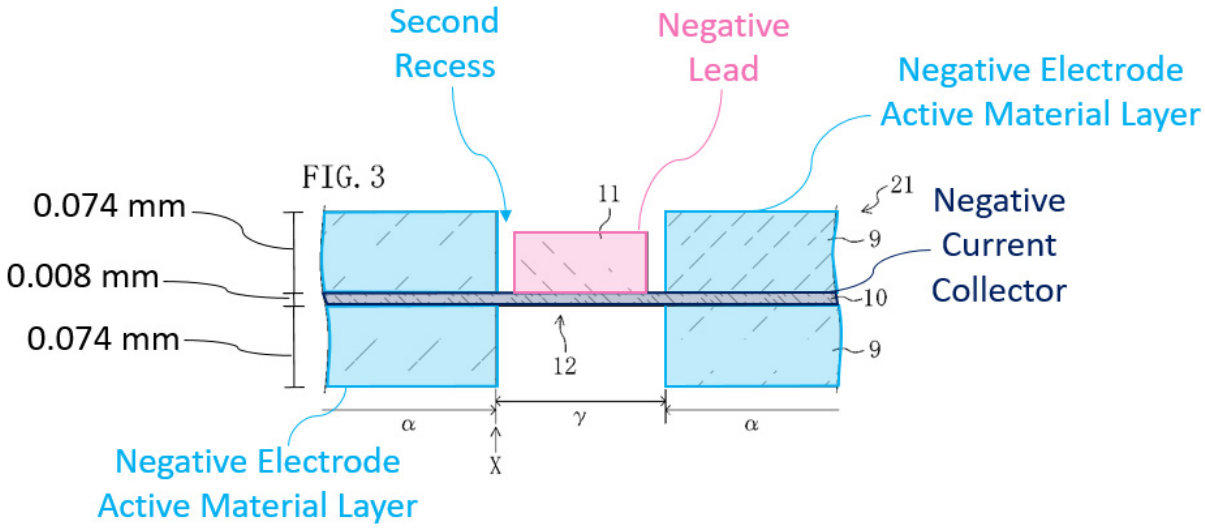

EX1005, FIG. 3 (annotated).



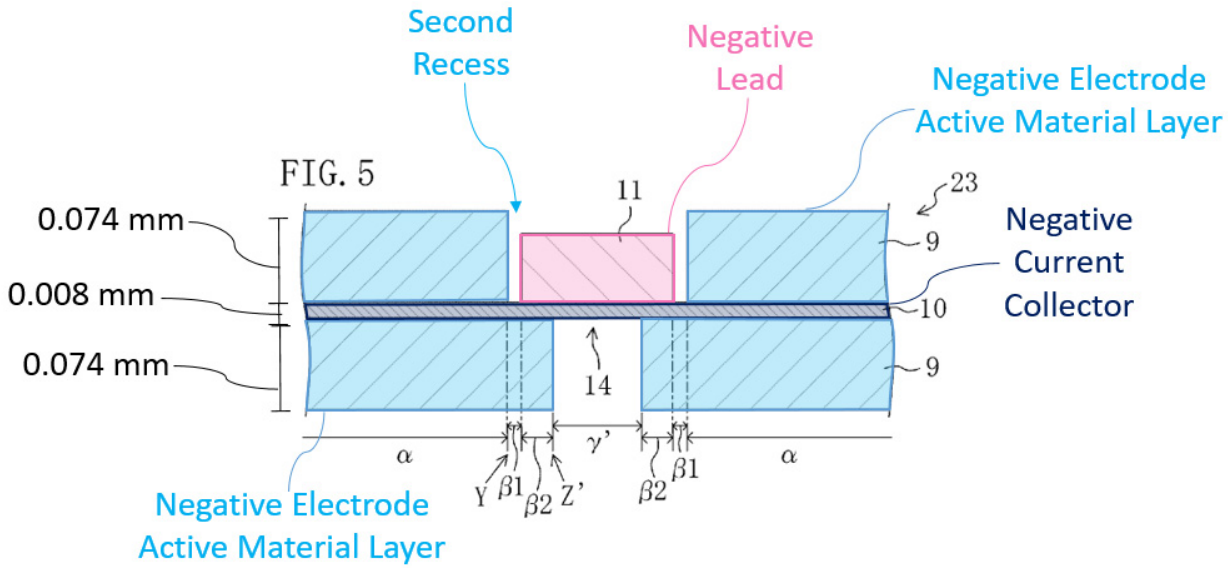

EX1005, FIG. 5 (annotated).

297. Similarly, for Battery 8, Sato discloses a negative electrode plate having "a thickness of 0.156 mm" (i.e., a thickness of 156 µm). EX1005, ¶[0107]. Sato's negative electrode plate includes an aluminum foil current collector "with a thickness of 8 µm." EX1005, ¶[0107]. A POSA would have understood that the thickness of each negative electrode active material layer applied on the surface of the negative current collector is 0.074 mm ($\frac{0.156\ mm - 0.008\ mm}{2}$). A POSA would have further understood that the depth of Sato's exposed portion corresponds to the thickness of the active material layer. Sato further describes connecting a "negative electrode lead (with a width of 4 mm)" to the exposed portion (i.e., the second recess) of Sato's negative electrode. EX1005, ¶[0112]. Given the disclosed depth

of Sato's recess and in view of Figures 3 and 5, reproduced below, a POSA would have understood that Sato's second recess (annotated) has a depth of 0.005-0.074 mm larger than the thickness of negative lead (11).




EX1005, FIG. 3 (annotated).




EX1005, FIG. 5 (annotated).

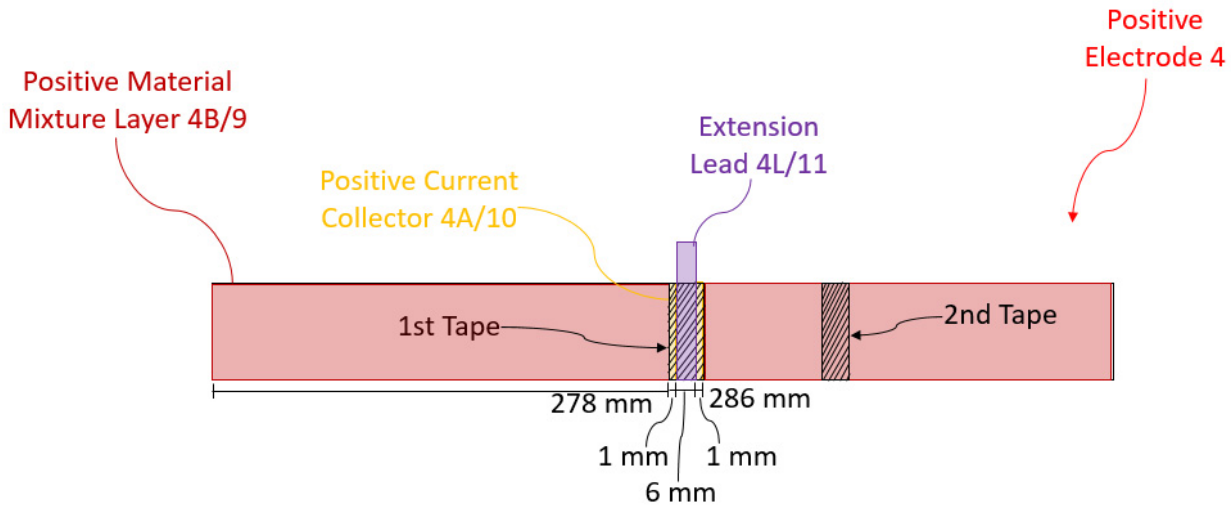
298. Furthermore, simply changing the thickness of Sato's lead to fit

within the recess would not lead to any unexpected results. A POSA would have also understood that there would have been a finite number of predictable solutions for connecting a lead to an electrode plate. Specifically, a POSA would have understood that there would have been three predictable solutions: (1) making the thickness of the lead greater than the depth of the recess, (2) making the thickness of the lead equal to the depth of the recess, and (3) making the thickness of the lead less than the depth of the recess. All three of these solutions would have been well within the level of ordinary skill in the art, leading to the predictable result of connecting the lead to the electrode plate. A POSA would also have understood that using a lead as thick or thicker than the recess depth could produce an undesirable bulge in the battery cell winding, which would not be an efficient use of space and would reduce cell capacity. Accordingly, it would have been obvious to use a lead thickness 0.005-0.1 mm less than the depth of Sato's recess.

**15. 16. "The lithium-ion battery of claim 9, wherein a width of a portion of the positive lead in the first recess is greater than a width of a remaining portion of the first recess not occupied by the positive lead located on one side of the positive lead."**

299. For the same reasons discussed above with respect to claim 8, Sato discloses a width of a portion of the positive lead in the first recess is greater than a width of a remaining portion of the first recess not occupied by the positive lead located on one side of the positive lead in the form of arranging a positive lead

having a width of 6 mm in an exposed portion of Sato's positive current collector 4A/10 having a width of 8 mm such that the remaining portion of Sato's exposed portion on one side of the positive lead is 1 mm. *See supra* Section IX.D.14; EX1005, ¶¶[0111]-[0112]. Specifically, Sato discloses that the exposed portion in positive electrode 4 has "a width of 8 mm" and that the positive electrode lead has "a width of 6 mm." EX1005, ¶¶[0111]-[0112]. Accordingly, the remaining portion of Sato's first recess located on one side of the positive lead is 1 mm ( $\frac{8\,mm-6mm}{2}$ ), which is less than the 6 mm width of Sato's positive electrode lead.




Sato, Positive Electrode.

# XIII. GROUND 5: CLAIMS 12, 13, AND 15 WOULD HAVE BEEN OBVIOUS IN VIEW OF IN VIEW OF SATO, TAKEMURA, AND KOBAYASHI FURTHER IN VIEW OF NAKAMURA

## A. Japanese Patent Pub. No. JP 2003-068271 to Nakamura *et al.* (Nakamura)

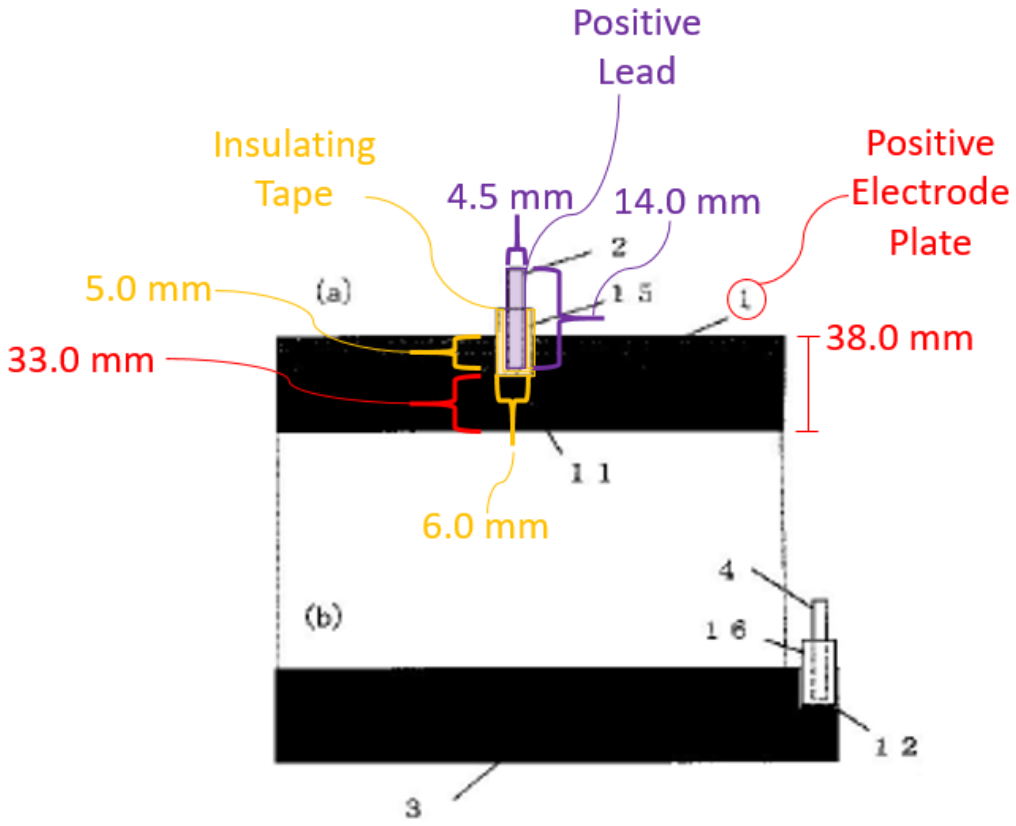
300. Nakamura discloses a lithium-ion battery as I discussed above in Section X.A.

## B. A POSA would have been motivated to combine Nakamura with Sato, Takemura, and Kobayashi with a reasonable expectation of success.

301. Nakamura, Sato, Takemura, and Kobayashi are analogous art as they all disclose coiled lithium-ion battery cells. EX1005, ¶[0001]; EX1006, ¶[0001]; EX1012, ¶[0007]; EX1008, ¶¶ [0014]-[0016]. Sato, Takemura, Kobayashi, and Nakamura disclose non-aqueous electrolyte coiled lithium-ion battery cells with insulating tapes configured to enhance reliability and prevent safety hazards within the battery cells. EX1005, ¶¶[0010], [0113]; EX1012, ¶¶[0025], [0028], [0034]-[0035], [0054]; EX1008, ¶[0013].

302. As I discussed above in the motivation to combine section of Ground 2 (Section X.B), Nakamura discloses dimensions—the width and length—of the active material-free portions (i.e., first and second recesses) on the positive and negative electrode plates that minimize the amount of active material removed from the electrode current collector when forming the material-free portions (i.e., recesses) in the electrodes while exposing enough surface of the current collector

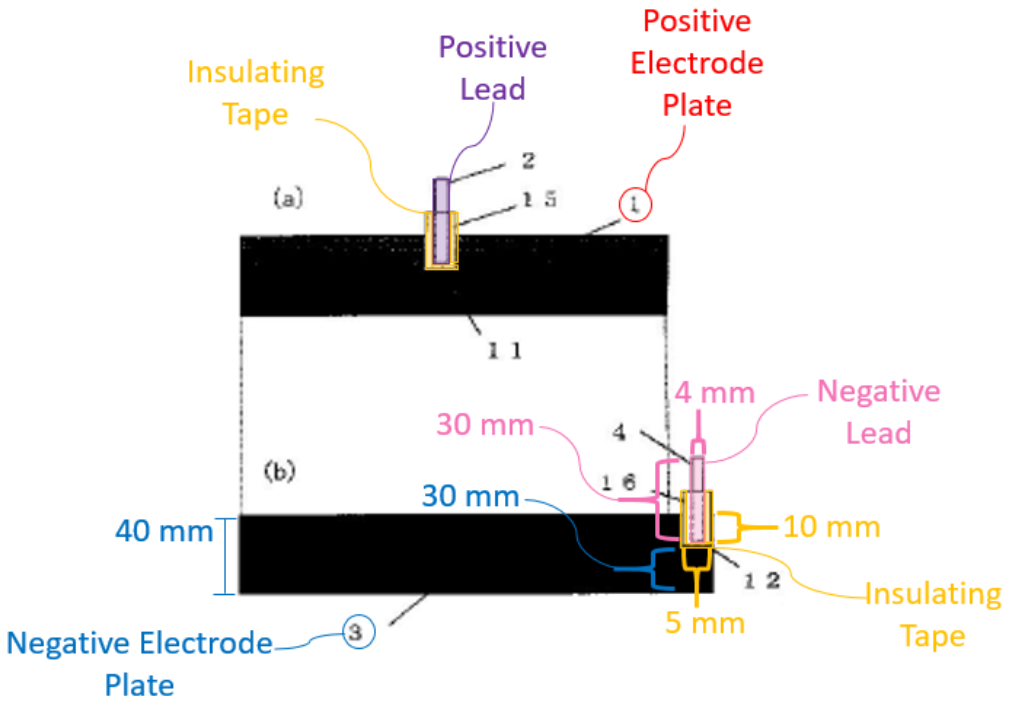
to attach a lead. EX1012, ¶¶[0005]-[0008], [0069]-[0073]. Specifically, Nakamura discloses providing the width (measured along a length of the positive electrode plate) of positive active material-free portion 11 (i.e., first recess) at 6.0 mm and the length (measured along a width of the positive electrode plate) of positive active material-free portion at 5.0 mm for a "positive electrode plate 1 with a width dimension of 38 mm and a length dimension of 355 mm." EX1012, ¶[0052]. These dimensions are illustrated in the following annotated figure.




EX1012, FIG. 1 (annotated).

303. Nakamura further discloses providing the length (measured along a width of the negative electrode plate) of the negative active material-free portion

12 at 10.0 mm and the width (measured along a length of the negative electrode) of the negative active material-free portion 12 at 5.0 mm for "a negative electrode plate 3 with a width dimension of 40 mm and a length dimension of 430 mm." EX1012, ¶¶ [0049], [0053]. These dimensions are illustrated in the annotated figure below.




EX1012, FIG. 1 (annotated).

304. To the extent that Sato does not explicitly disclose all the claimed ranges of dimensions for the recesses of the '498 patent's positive and negative electrodes, it would have been obvious to a POSA to make the dimensions of the recesses of Sato's positive and negative electrodes according to the dimensions taught by Nakamura. Such modification would have preserved more active

material provided on the current collector of Sato's electrode plate, thereby increasing the capacity of Sato's battery, as modified by Takemura and Kobayashi. EX1012, ¶¶[0005]-[0008], [0069]-[0073]. Thus, a POSA would have been motivated to combine the teachings of Sato, Takemura, Kobayashi, and Nakamura because modifying the dimensions of the recesses in Sato's positive and negative electrodes would have increased the storage capacity of Sato's battery.

305. A POSA would also have had a reasonable expectation of success in combining the teachings of Nakamura with Sato, Takemura, and Kobayashi because modifying the dimensions of the active material coated on the current collector was common in lithium-ion batteries well before 2014. *See* EX1012, ¶¶[0005]-[0008], [0069]-[0073]. A POSA would have expected Sato's electrodes, as modified by Takemura, Kobayashi and Nakamura, to perform its intended function of enabling the flow of electrons and ions. Combining the teachings of Nakamura's recess dimensions with Sato's battery, as modified by Takemura and Kobayashi, would have amounted to nothing more than applying a known technique—Nakamura's recess dimensions—to a known device—Sato's battery as modified by Takemura and Kobayashi—to achieve the expected result of increasing the battery's storage capacity.

### C. The combination of Sato, Takemura, and Nakamura discloses or renders obvious every element of claims 12, 13, and 15.

306. The following explains how each claimed element of the '498 patent

is disclosed by Sato, Takemura, Kobayashi, and/or Nakamura. In view of Sato's, Takemura's, Kobayashi's, and Nakamura's disclosures, a POSA would have modified Sato in view of Takemura, Kobayashi, and Nakamura to arrive lithium-ion batteries as claimed in the '498 patent.

**1. 12. "wherein the first recess has a length of 1-100 mm less than a length of the positive lead, the first recess has a width of 1-10 mm larger than a width of the positive lead, the second recess has a length of 1-100 mm less than a length of the negative lead, and the second recess has a width of 1-10 mm larger than a width of the negative lead."**

**a. Sato**

307. For one example battery (Battery 1), Sato discloses the first recess (exposed portion 12/14 on positive electrode 4) having a width (i.e., 8 mm) of 1-10 mm larger (i.e., 2 mm) than a width (i.e., 6 mm) of the positive lead (lead 4L/11). EX1005, ¶¶[0111]-[0113]. Specifically, Sato discloses that "a portion where the positive electrode current collector was exposed had a width of 8 mm from the position of 278 mm to the position of 286 mm in the length direction relative to the end." EX1005, ¶[0111]. Sato further discloses that "[a]n aluminum positive electrode lead (with a width of 6 mm) was attached to the lead connection surface from which the mixture layer of the positive electrode current collector had been peeled off." EX1005, ¶[0113]. A POSA would have understood that Sato's first recess (exposed portion 12/14 on positive electrode 4) has a width that is 2 mm larger than the width of positive lead 4L/11.

308. Furthermore, Sato discloses the second recess (exposed portion 12/14 on negative electrode 5) having a width (i.e., 6 mm) that is 1-10 mm larger than a width (i.e., 4 mm) of the negative lead (lead 5L/11). EX1005, ¶¶[0112], [0137]. Specifically, Sato discloses that "a nickel negative electrode lead (with a width of 4 mm) was attached to the negative electrode current collector." EX1005, ¶[0112]. Sato also discloses "a portion where the negative electrode current collector was exposed had a width of 6 mm from the position of 372 mm to the position of 378 mm relative to an end of the negative plate in the length direction." EX1005, ¶[0137]. A POSA would have understood that Sato's second recess (exposed portion 12/14 on negative electrode 5) has a width that is 2 mm larger than the width of negative lead 5L/11.

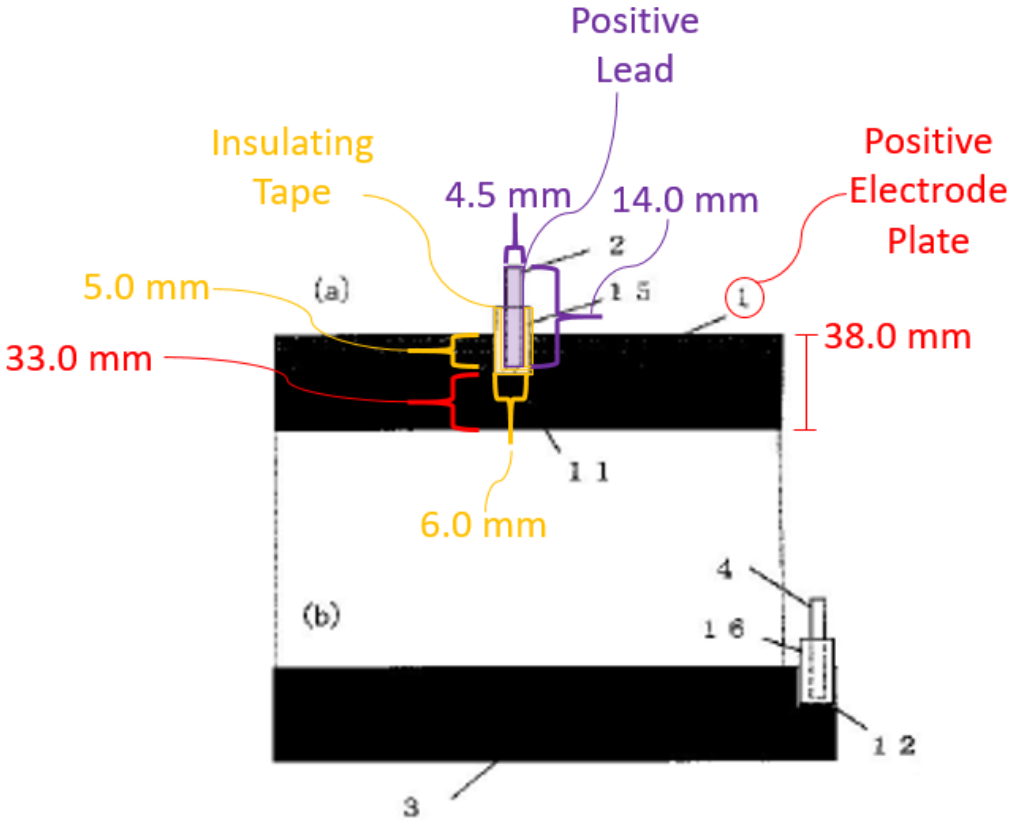
309. Sato is silent about the "the first recess has a length of 1-100 mm less than a length of the positive lead" and "the second recess has a length of 1-100 mm less than a length of the negative lead." However, providing recesses on positive and negative electrodes with a length of 1-100 mm less than a length of a positive and negative lead was well known, as evidenced by Nakamura.

**b. Nakamura**

310. To the extent Sato does not explicitly disclose the recesses having the lengths as claimed, Nakamura discloses that modifying the length of the electrode's recesses to be within the recited dimension ranges of claim 12 would

have been obvious.

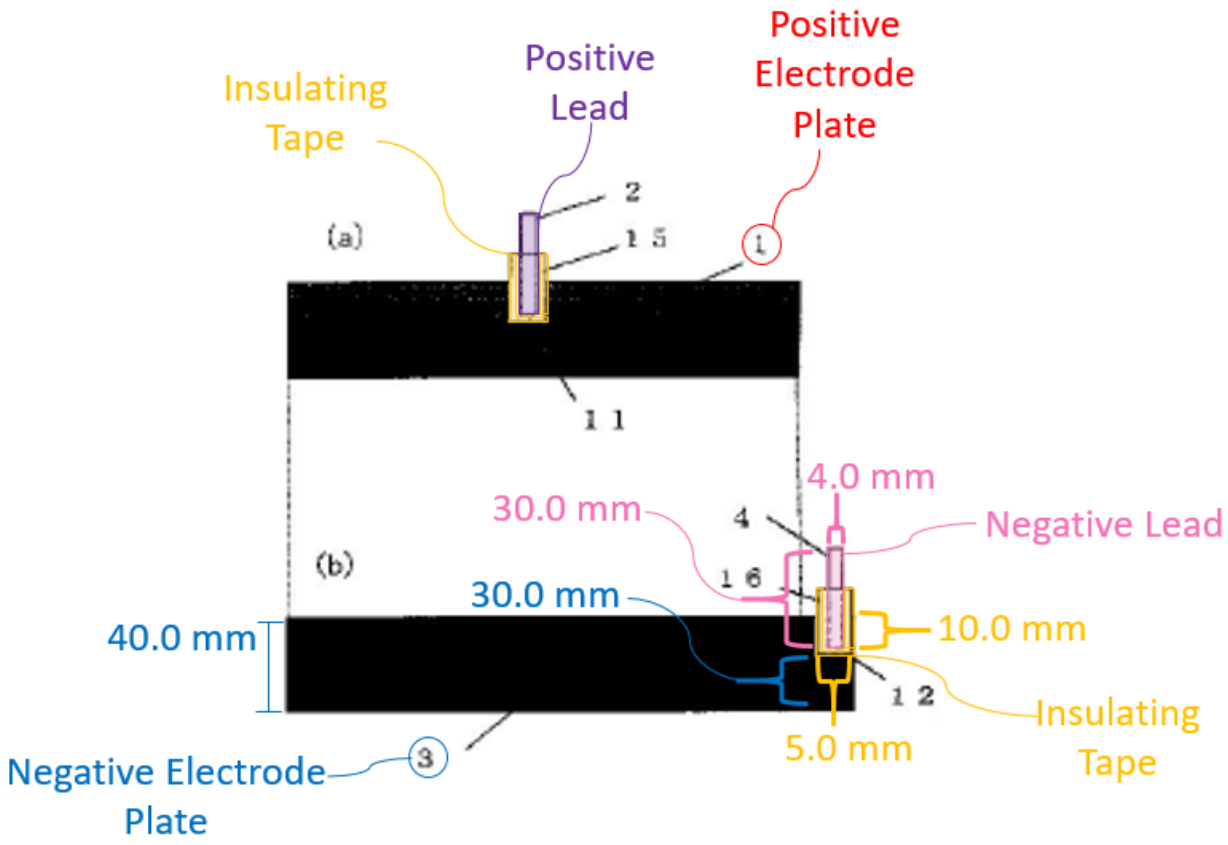
311. Nakamura discloses providing a positive active material-free portion 11 (i.e., a first recess) in a positive electrode plate 1 with a length of 5.0 mm (measured along a width of the positive electrode plate) and a width of 6.0 mm (measured along a length of the positive electrode plate). EX1012, ¶[0052]. Nakamura discloses providing a positive lead 2 with a length of 14.0 mm (measured along a width of the positive electrode plate) and a width of 4.5 mm (measured along a length of the positive electrode plate). EX1012 ¶[0052]. A POSA would have understood that Nakamura's first recess (material-free portion 11) has a length of 9.0 mm less than a length of positive electrode lead 2 (positive lead's 14.0 mm length – positive material-free portion's 5 mm length). A POSA would also have understood that Nakamura's first recess (material-free portion 11) has a width of 1.5 mm larger than a width of the positive lead 2 (positive material-free portion's 6.0 mm width – positive lead's 4.5 mm width).




EX1012, FIG. 1 (annotated).

312. Nakamura discloses providing a negative active material-free portion 12 (i.e., a second recess) in a negative electrode plate 3 with a length of 10.0 mm (measured along a width of the negative electrode plate) and a width of 5.0 mm (measured along a length of the negative electrode plate). EX1012, ¶¶[0049], [0053]. Nakamura discloses providing a negative lead 4 with a length of 30.0 mm (measured along a width of the negative electrode) and a width of 4.0 mm (measured along a length of the negative electrode plate). EX1012, ¶[0053]. A POSA would have understood that Nakamura's second recess (material-free portion 12) has a length of 20 mm less than a length of the negative electrode lead

4 (lead's 30.0 mm length – negative material-free portion's 10.0 mm length). A POSA would have understood that Nakamura's second recess (material-free portion 12) has a width of 1.0 mm larger than a width of the negative lead 4 (negative material-free portion's 5.0 mm width – negative lead's 4.0 mm width).




EX1012, FIG. 1 (annotated).

313. Further, even assuming that paragraph [0053] of Nakamura correctly describes that negative active material-free portion 12 has a length (measured

along the width of electrode plate) of 30 mm,[10] a POSA would have been motivated to form the length of negative active material-free portion 12 in its "preferred" range of "5 mm to 15 mm," as described in paragraph [0034]. Specifically, Nakamura describes that reducing the length of negative active material-free portion 12 to be significantly less than the width of negative electrode plate 3 reduces the "amount of insulating tape" used to cover the exposed metal of negative electrode plate 3, thereby "lowering production costs." EX1012, ¶[0034]. Forming the length of negative active material-free portion 12 in the battery embodiment described in paragraph [0053] according to the preferred range of 5 mm to 15 mm described in paragraph [0034] results in Nakamura's second recess (material-free portion 12) having a length of 15 mm to 25 mm less than a length of the negative electrode lead 4 (lead's 30.0 mm length – negative material-free portion's 5 mm to 15 mm length). Thus, a POSA would have understood that Nakamura discloses or at least renders obvious the recess dimensions that over the

[10] As I explained above in footnote 7, a POSA would have understood that the 10 mm length ("10.0 mm in the width direction") of negative material-free portion 12 described in paragraph [0049] applies to negative active material-free portion 12 described in paragraph [0053] to be consistent with the remaining disclosure (e.g., paragraph [0034] and Figure 1) of Nakamura.

recess dimension ranges recited in claim 12.

**c. Combination of Sato, Takemura, Kobayashi, and Nakamura.**

314. In view of Sato's, Takemura's, Kobayashi's and Nakamura's disclosures, it would have been obvious to a POSA to form the length of Sato's first and second recesses to be 1-100 mm less than a length of the positive and negative leads. Modifying the length of Sato's recesses, as taught by Nakamura, would have preserved more active material applied to the electrode's current collector when forming the recesses in the active material, thereby increasing the storage capacity of Sato's battery, as modified by Takemura and Kobayashi. Increasing the capacity of Sato's battery would allow Sato's battery to supply power for an extended period of time. EX1012, ¶¶[0008], [0069]-[0073]. Modifying the length of Sato's first and second recesses to be 1-100 mm less than a length of the positive and negative leads would have simply been applying a known technique (modifying the dimensions of the electrode's recesses) to a known device (Sato's battery as modified by Takemura and Kobayashi) to achieve the predictable result of improving the battery's storage capacity and reducing manufacturing costs.

315. Accordingly, a POSA would have understood that the combined disclosures of Sato, Takemura, Kobayashi, and Nakamura render claim 12 obvious.

**2. 13. "wherein the first recess has a length of 1-100 mm less than a width of the positive electrode active material layer, and the second recess has a length of 1-100 mm less than a width of the negative electrode active material layer."**

**a. Sato**

316. For one example (Battery 1), Sato discloses applying a coating of an electrode material mixture layer to a positive electrode plate having a width of 57 mm. EX1012, ¶[0104]. Recognizing that Sato's material mixture layer is applied across the width of the electrode plate, a POSA would have understood that the width of Sato's positive active material layer corresponds to the width of the electrode plate—57 mm.

317. Similarly, for Battery 8, Sato discloses applying a coating of an electrode material mixture layer to a negative electrode plate having a width of 58.5 mm. EX1012, ¶[0107]. Recognizing that Sato's material mixture layer is applied across the width of the electrode plate, a POSA would have understood that the width of Sato's negative active material layer corresponds to the width of the electrode plate—58.5 mm.

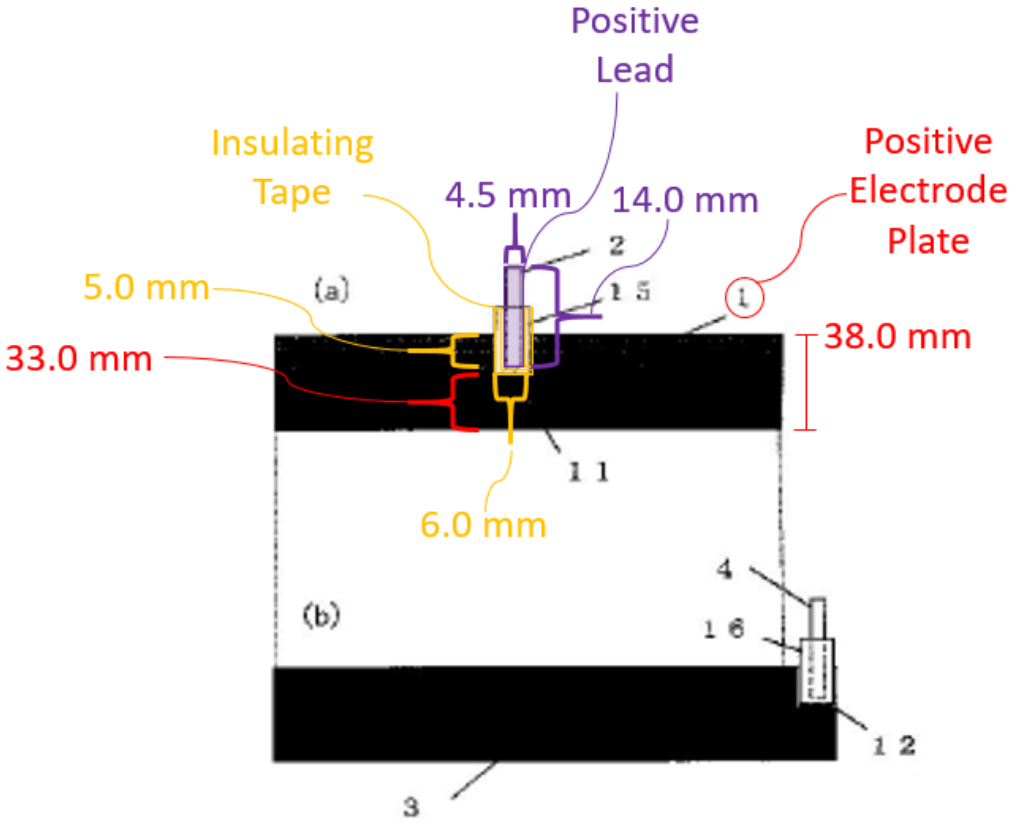
318. Sato is silent about "the first recess has a length of 1-100 mm less than a width of the positive electrode active material layer" and "the second recess has a length of 1-100 mm less than a width of the negative electrode active material layer." However, providing recesses on positive and negative electrodes with a length of 1-100 mm less than a width of a positive and negative electrode active

material layer was well known, as evidenced by Nakamura.

**b. Nakamura**

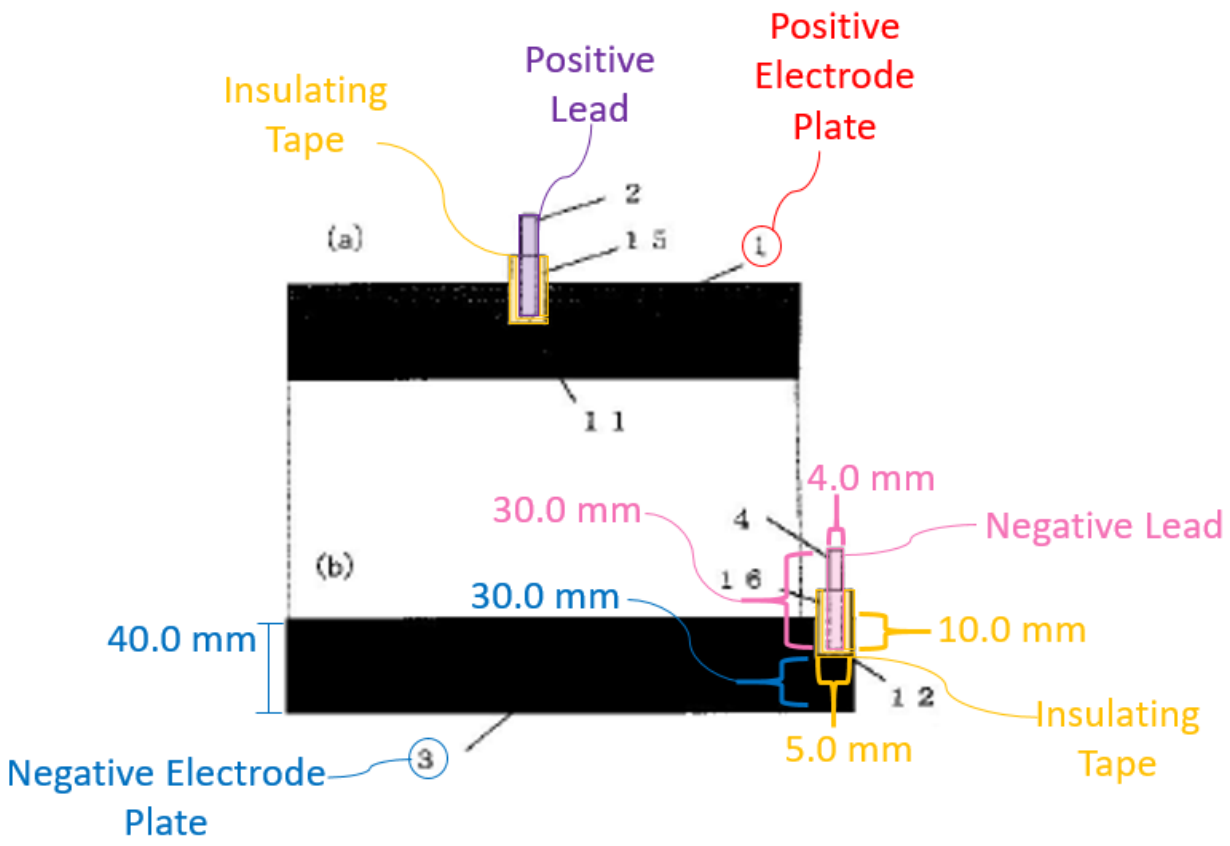
319. To the extent Sato does not explicitly disclose the first recess having a length of 1-100 mm less than a width of a positive electrode active material layer and the second recess having a length of 1-100 mm less than a width of a positive electrode active material layer, Nakamura discloses that modifying the length of the electrode's recesses to be within the recited dimension ranges of claim 13 would have been obvious.

320. Nakamura discloses providing a positive active material-free portion 11 (i.e., the first recess) in a positive electrode plate 1 with a length of 5.0 mm (measured along a width of the positive electrode plate). EX1012, ¶[0052]. Nakamura's positive electrode plate 1 has "a width dimension of 38 mm." EX1012, ¶[0052]. Recognizing that the width of Nakamura's active material mixture layer corresponds to the width of the electrode plate, a POSA would have understood that the length of Nakamura's first recess (material-free portion 11) is 33 mm less than a width of positive electrode active-material layer (38 mm– 5 mm).




EX1012, FIG. 1 (annotated).

321. Nakamura further discloses providing a negative active material-free portion 12 (i.e., the second recess) in a negative electrode plate 3 with a length of 10.0 mm (measured along a width of the negative electrode plate). EX1012, ¶[0053]. Nakamura's negative electrode plate 3 has "a width dimension of 40 mm." EX1012, ¶[0053]. A POSA would have understood that the length of Nakamura's second recess (material-free portion 12) is 30 mm less than a width of negative electrode active-material layer (40 mm – 10 mm).




EX1012, FIG. 1 (annotated).

322. Further, even assuming that paragraph [0053] of Nakamura correctly describes that negative active material-free portion 12 has a length (measured along the width of electrode plate) of 30 mm,[11] a POSA would have been

[11] As I explained above in footnote 7, a POSA would have understood that the 10 mm length ("10.0 mm in the width direction") of negative material-free portion 12 described in paragraph [0049] applies to negative active material-free

motivated to form the length of negative active material-free portion 12 in its "preferred" range of "5 mm to 15 mm," as described in paragraph [0034]. Specifically, Nakamura describes that reducing the length of negative active material-free portion 12 to be significantly less than the width of negative electrode plate 3 reduces the "amount of insulating tape" used to cover the exposed metal of negative electrode plate 3, thereby "lowering production costs." EX1012, ¶[0034]. Forming the length of negative active material-free portion 12 in the battery embodiment described in paragraph [0053] according to the preferred range of 5 mm to 15 mm described in paragraph [0034] results in the length of Nakamura's second recess (material-free portion 12) being 25 mm to 35 mm less than a width of negative electrode active-material layer (40 mm – 5 mm to 15 mm). Thus, a POSA would have understood that Nakamura discloses or at least renders obvious the first and second recess dimensions that overlap the recess dimension ranges recited in claim 13.

**c. Combination of Sato, Takemura, Kobayashi, and Nakamura.**

323. In view of Sato's, Takemura's, Kobayashi's, and Nakamura's disclosures, it would have been obvious to a POSA to form the length of Sato's

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portion 12 described in paragraph [0053] to be consistent with the remaining disclosure (e.g., paragraph [0034] and Figure 1) of Nakamura.

first and second recesses to be 1-100 mm less than a width of the positive and negative electrode active material mixture layers. Modifying the length of Sato's recesses, as taught by Nakamura, would have preserved more active material applied to the electrode's current collector when forming the recesses in the active material, thereby increasing the capacity of Sato's battery, as modified by Takemura and Kobayashi. Increasing the storage capacity of Sato's battery would allow Sato's battery to supply power for an extended period of time. EX1012, ¶¶[0008], [0069]-[0073]. Modifying the length of Sato's first and second recesses to be 1-100 mm less than a width of the positive and negative electrode active material mixture layers would have simply been applying a known technique (modifying the dimensions of the electrode's recesses) to a known device (Sato's battery as modified by Takemura and Kobayashi) to achieve the predictable result of improving the battery's storage capacity and reducing manufacturing costs.

324. Accordingly, a POSA would have understood that the combined disclosures of Sato, Takemura, Kobayashi, and Nakamura render claim 13 obvious.

### 3. 15. "wherein a length of a portion of the positive lead in the first recess is less than a width of a remaining portion of the positive electrode active material layer from an edge of the first insulating glue layer covering the positive electrode

**active material layer to an edge of the positive electrode active material layer opposite to the first recess."**

**a. Sato**

325. For one example (Battery 1), Sato discloses applying a coating of an electrode material mixture layer to a positive electrode plate having a width of 57 mm. EX1005, ¶[0104]. Recognizing that Sato's material mixture layer is applied across the width of the electrode plate, a POSA would have understood that the width of Sato's positive active material layer corresponds to the width of the electrode plate—57 mm.

326. Sato also discloses that "a portion where the positive electrode current collector was exposed had a width of 8 mm from the position of 278 mm to the position of 286 mm in the length direction relative to the end." EX1005, ¶[0111]. Sato further discloses that "[a]n aluminum positive electrode lead (with a width of 6 mm) was attached to the lead connection surface from which the mixture layer of the positive electrode current collector had been peeled off." EX1005, ¶[0113].

327. Sato is silent about the dimensions of the positive electrode's exposed portion 12/14 (i.e., the first recess) relative to a width direction of the positive electrode 4 and the length of positive lead 4L/11. Accordingly, Sato does not explicitly disclose that "a length of a portion of the positive lead in the first recess is less than a width of a remaining portion of the positive electrode active material layer from an edge of the first insulating glue layer covering the positive electrode

active material layer to an edge of the positive electrode active material layer opposite to the first recess."

328. However, providing a lead in a first recess of a positive electrode with a length less than a width of a remaining portion of the positive electrode active material layer from an edge of the first insulating tape covering the positive electrode active material layer to an edge of the positive electrode active material layer opposite to the first recess was well known, as evidenced by Nakamura.

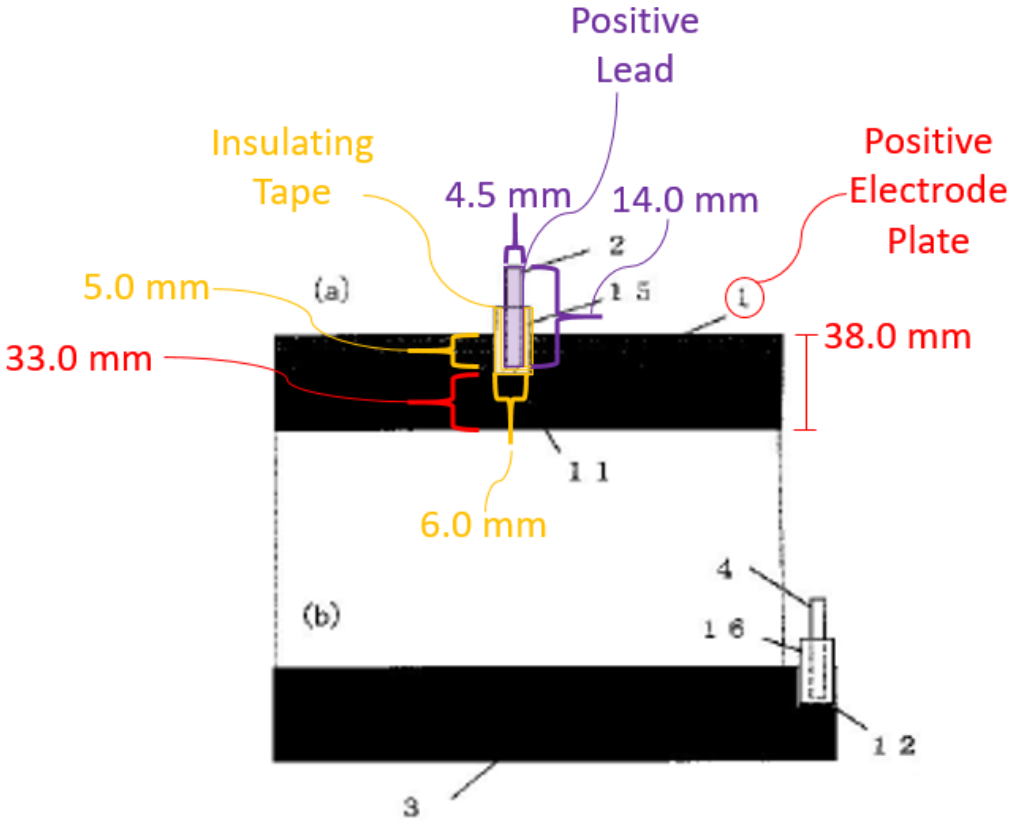
**b. Nakamura**

329. To the extent Sato does not explicitly disclose the recited dimension ranges of claim 15, Nakamura discloses that modifying the dimensions of the electrode's recesses and lead connection to be within the recited dimension ranges of claim 15 would have been obvious.

330. Nakamura discloses providing a positive active material-free portion 11 (i.e., a first recess) in a positive electrode plate 1 with a length of 5.0 mm (measured along a width of the positive electrode plate). EX1012, ¶[0052]. Nakamura's positive electrode lead 2 is "14.00 mm long." EX1012, ¶[0052]. A POSA would have understood that the length of the portion of positive electrode lead 2 located in material-free portion 11 is less than the length of material-free portion 11. EX1012, FIG. 1. Accordingly, the length of the portion of positive electrode lead 2 located in material-free portion 11 (i.e., the first recess) of

Nakamura's positive electrode plate 1 is less than 5.0 mm.

331. Nakamura further discloses that positive electrode plate 1 has "a width dimension of 38 mm." EX1012, ¶[0052]. Recognizing that Nakamura's active material mixture layer is applied across the width of the electrode plate, a POSA would have understood that the width of the remaining portion of Nakamura's active material mixture layer from an edge of the insulating tape 15 covering the positive electrode active material layer to an edge of the positive electrode active material layer opposite to the material-free portion 11 is 33.0 mm, as annotated below in Figure 1. Thus, the length (less than 5.0 mm) of the portion of Nakamura's positive lead 2 in material-free portion 11 is less than a width (33.0 mm) of the remaining portion of Nakamura's positive electrode active material layer defined from an edge of insulating tape 15 to an edge of the positive electrode active material layer opposite to material-free portion 11.




EX1012, FIG. 1 (annotated).

332. Thus, Nakamura discloses active material layer and recess dimensions that overlap active material layer and recess dimension ranges recited in claim 15.

**c. Combination of Sato, Takemura, Kobayashi, and Nakamura.**

333. In view of Sato's, Takemura's, Kobayashi's, and Nakamura's disclosures, it would have been obvious to a POSA to make the length of a portion of Sato's positive lead 4L/11 in exposed portion 12/14 (i.e., the first recess) to be less than a width of a remaining portion of Sato's positive electrode active material layer 4B/9 defined from the edge of Sato's adhesive tape covering the positive lead 4L/11 to an edge of Sato's positive active material layer 4B/9 opposite to exposed

portion 12/14. Modifying the dimensions of Sato's exposed portion 12/14 relative to a width direction of positive electrode plate 4, as taught by Nakamura, would have increased the volume of active material applied to the electrode's current collector, thereby increasing the storage capacity of Sato's battery, as modified by Takemura and Kobayashi. Increasing the storage capacity of Sato's battery would allow Sato's battery to supply power for an extended period of time. EX1012, ¶¶[0008], [0069]-[0073]. Modifying the length of Sato's lead 4L/11 in exposed portion 12/14 to be less than a width of the remaining portion of Sato's positive active material layer 4B/9 would have simply been applying a known technique (modifying the dimensions of the electrode's recesses) to a known device (Sato's battery as modified by Takemura and Kobayashi) to achieve the predictable result of improving the battery's storage capacity.

334. Accordingly, a POSA would have understood that the combined disclosures of Sato, Takemura, Kobayashi, and Nakamura render claim 15 obvious.

## XIV. GROUND 6: DEPENDENT CLAIM 21 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO, TAKEMURA, KOBAYASHI, OH-539, AND OH-144.

### A. U.S. Patent Pub. No. 2011/0104539 to Oh *et al.* (Oh-539)

335. Oh-539 discloses a lithium-ion battery as I discussed above in Section XI.A.

### B. U.S. Patent Pub. No. 2010/0035144 to Oh (Oh-144)

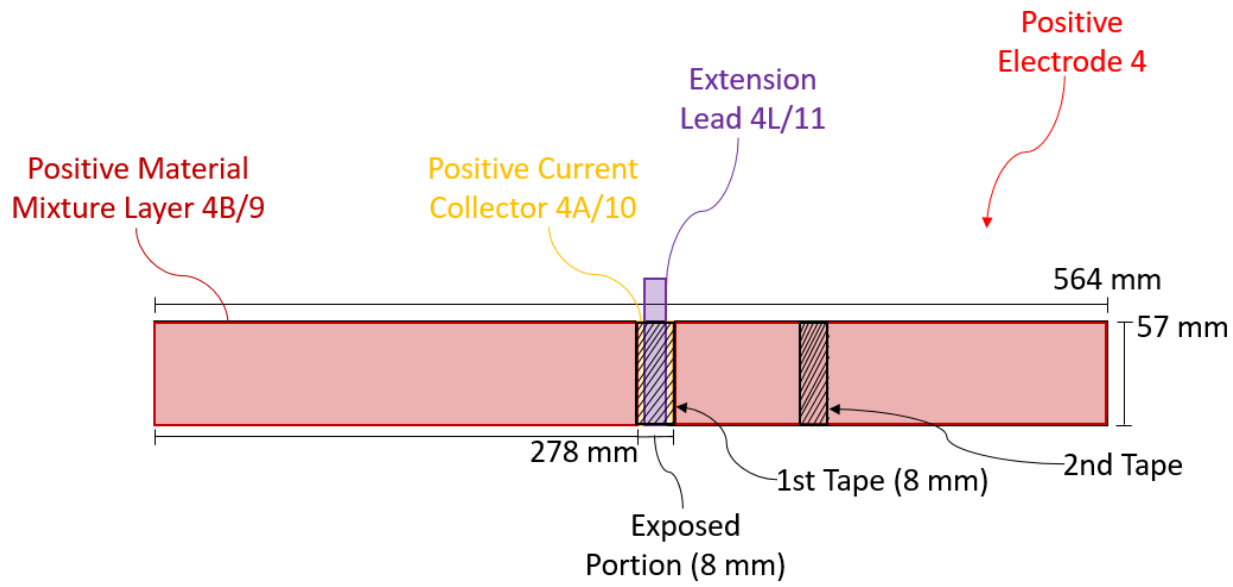
336. Oh-144 discloses a lithium-ion battery as I discussed above in Section XI.B.

### C. A POSA would have been motivated to combine Oh-539 and Oh-144 with Sato, Takemura, and Kobayashi with a reasonable expectation of success.

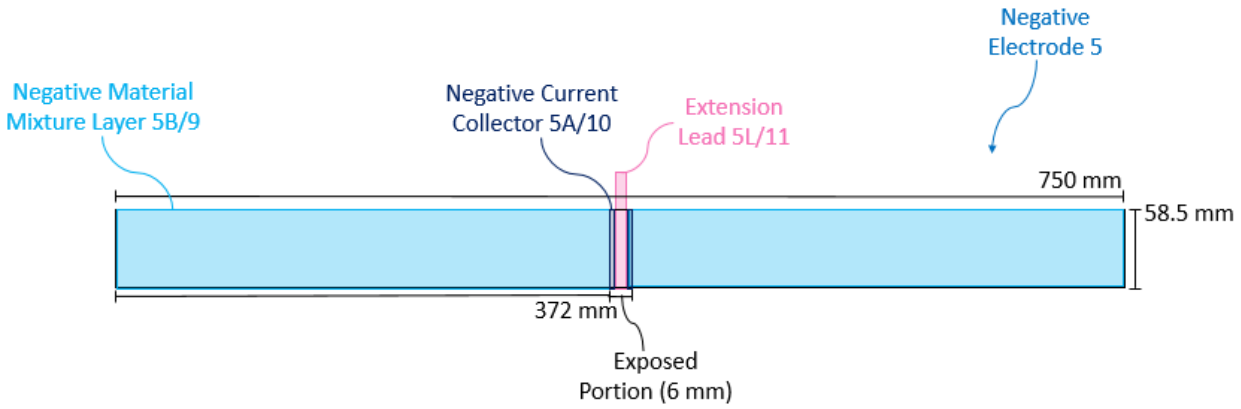
337. Sato, Takemura, Kobayashi, Oh-539, and Oh-144 are analogous art as they all disclose coiled lithium-ion battery cells. EX1005, ¶¶[0001], [0013]; EX1006, ¶[0001]; EX1007, ¶¶[0007], [0029]; EX1008, ¶¶[0014]-[0016]; EX1017, ¶¶[0025]-[0027].

#### 1. Motivation to combine Oh-539 with Sato, Takemura, and Kobayashi

338. As I discussed above in Section XII.D, the combination of Sato with Takemura and Kobayashi renders obvious a lithium-ion battery as recited claim 9. In this combination, the positive electrode and the negative electrode would have the following construction disclosed by Sato. *See supra* Section XII.D.



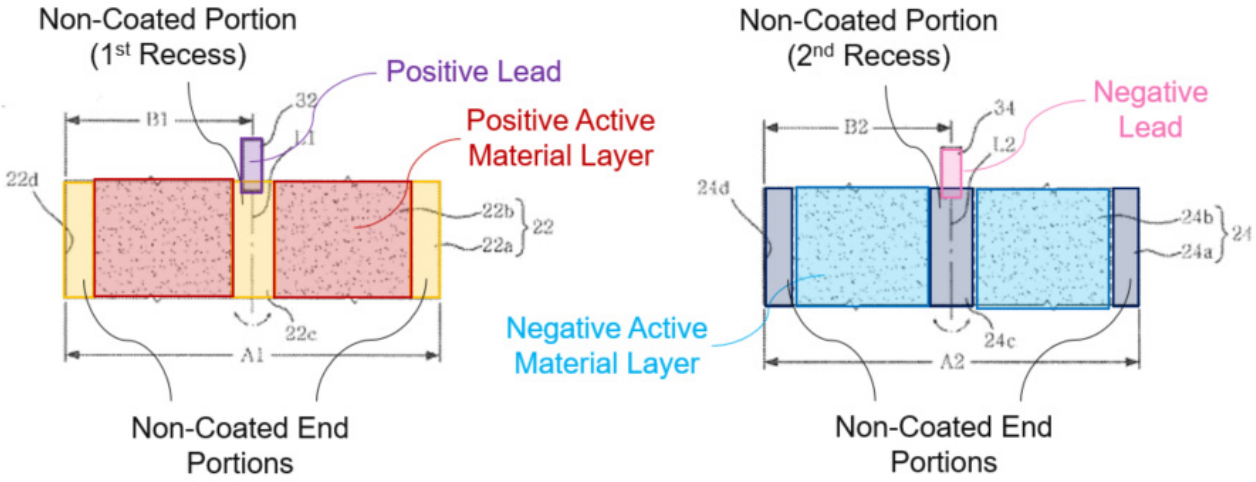

Sato's Positive Electrode.




Sato's Negative Electrode.

339. For the same reasons discussed above in Section XI.C.1, it would have been obvious to make Sato's electrodes, as modified by Takemura and Kobayashi, using the method described by Oh-539. *See supra*, Section XI.C.1. Specifically, a POSA would have been motivated to use Oh-539's method to make Sato's electrodes having centrally located recesses for the attachment of leads. Oh-

539's method was a known method of cost-effectively creating electrodes with centrally located recesses like those disclosed in Sato. Using Oh-539's method to make Sato's electrodes would reduce cutting tool wear and/or dust creation because Oh-539 cuts through only exposed, non-coated metal on the electrodes. Furthermore, a POSA would have also had a reasonable expectation of success combining the teachings of Oh-539's method to create Sato's electrodes. Doing so would have simply been applying a known, easily repeatable technique—coating and cutting electrode plates at regular intervals—to create a known electrode construction with centrally located recesses for the attachment of leads. This modification would result in the Sato-Takemura-Kobayashi battery having electrodes having the same layout as Oh-539's electrodes, as shown in the following annotated figures.




EX1007, FIGs. 2 and 3 (annotated).

### 2. Motivation to combine Oh-144 with Sato, Takemura, Kobayashi, and Oh-539

340. As discussed above in Section XI.C.2, a POSA would have understood that exposed metal at the non-coated end portions 22a are susceptible to short-circuiting when wound with a separator to form the battery. *See supra*, Section XI.C.2. For the same reasons discussed in Section XI.C.2, a POSA would have been motivated to add Oh-144's tapes 170A, 170B to inner and out surface of the exposed ends in Sato's battery, as modified by Takemura, Kobayashi, and Oh-539, such that a winding end of Sato's modified negative plate is located between the two tapes and the two tapes extend over the winding end to prevent short circuits. *See supra* Section XI.C.2. Specifically, adding these two tapes would have helped prevent short circuits caused by contact between uncoated end portions on the cathode and anode located at the winding end of the battery coil. Oh-144 teaches that positioning two tapes in this manner prevents short circuits in pouch-type or cylindrical wound battery coils, like those in Sato, Takemura, Kobayashi, and Oh-539. EX1005, ¶[0084]; EX1006, ¶[0032]; EX1007, ¶[0092]; EX1017, Abstract, ¶¶[0041]-[0042], [0045]. Thus, adding insulating tapes as disclosed by Oh-144 would simply have been applying a known technique—placing tapes on the positive electrode around exposed metal at the winding end of the negative electrode—to improve a known device—the Sato-Takemura-Kobayashi-Oh-539 battery—to prevent short-circuiting.

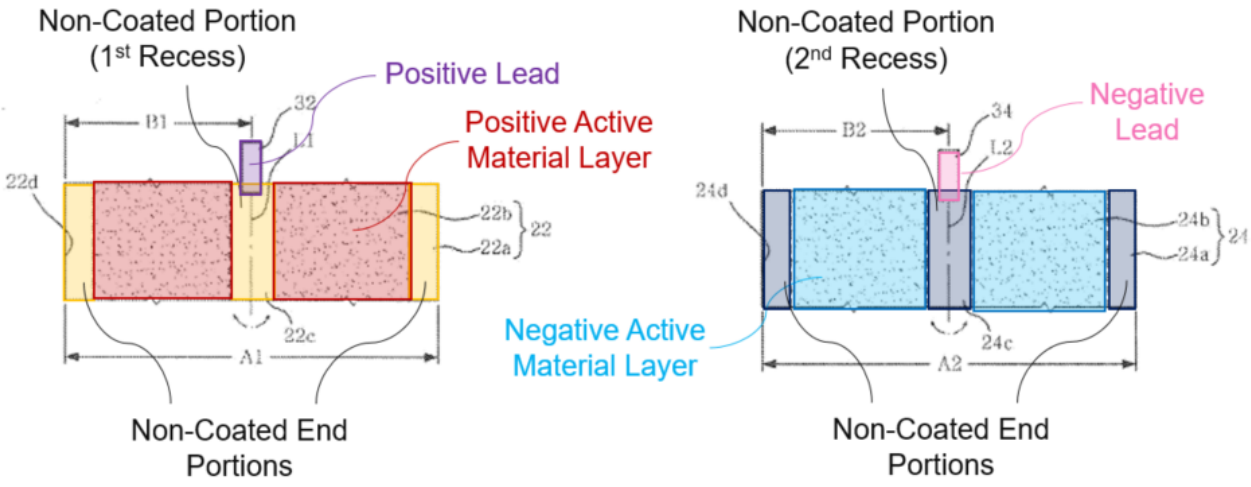
341. A POSA would also have had a reasonable expectation of success combining Sato, Takemura, Kobayashi, Oh-539, and Oh-144 because applying insulating tapes in coiled lithium-ion battery cells was a common solution for preventing short-circuiting well before 2014. EX1006, ¶¶[0003], [0008], [0022]; EX1009, ¶[0008]; EX1010, ¶[0029]; EX1011, ¶[0009], [0014]. A POSA would have expected Oh '144's tapes 170A, 170B incorporated into the Sato-Takemura-Kobayashi-Oh-539 battery to perform their intended function of insulating exposed metal to prevent short-circuiting at the winding end of the coil.

### D. The combination of Sato, Takemura, Kobayashi, Oh-539, and Oh-144 renders obvious claim 21.

342. Claim 21 recites "two insulating layers are disposed on two opposite surfaces of the positive plate, and a winding end of the negative plate is located between the two insulating layers; and the two insulating layers extend over the winding end of the negative plate along the winding direction."

#### 1. Sato-Takemura-Kobayashi-Oh-539 Combination

343. As I discussed above in Section XIV.C.1, it would have been obvious to use Oh-539's method to make Sato's positive and negative electrodes such that Sato's electrodes have the same layout as Oh-539's electrodes, as shown in the following annotated figures.

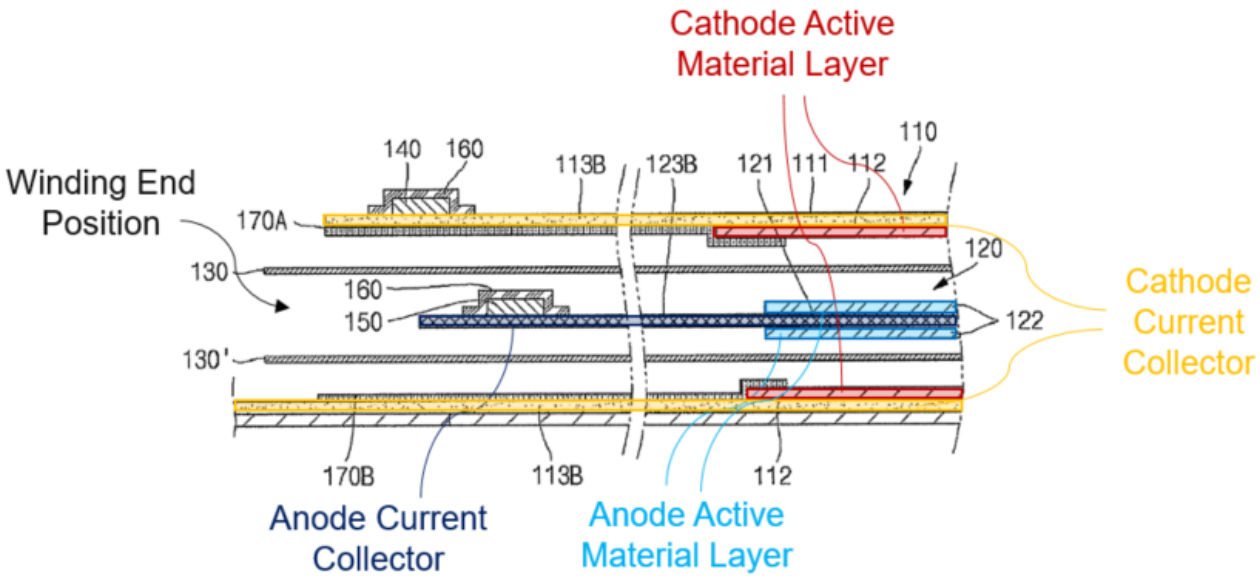



EX1007, FIGs. 2-3 (annotated).

344. The combination of Sato, Takemura, Kobayahsi, Oh-539 does not explicitly disclose two insulating layers disposed on opposite surfaces of the positive plate such that a winding end of the negative plate is located between the two layers and the two layers extend over the winding end.

**2. Oh-144**

345. Oh-144 discloses two tapes 170A, 170B disposed on the cathode plate 110 at the winding end portion of the anode plate 120 to prevent short circuits that could be caused by contact between exposed metal at the winding end. EX1017, ¶¶[0038], [0039]; The first tape 170A covers the bottom (inner side) surface of the uncoated cathode portion 113B above exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0038]. The second tape 170B covers a top (outer side) surface of the uncoated cathode portion 113B below exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0039].




EX1017, FIG. 4 (annotated).

### 3. Sato-Takemura-Kobayashi-Oh-539-Oh-144 Combination

346. It would have been obvious to position Oh-144's tapes 170A, 170B on inner and outer surface of non-coated end portions of the positive electrode in the Sato-Takemura-Kobayashi-Oh-539 battery, as shown above.

347. By positioning Oh-144's tapes 170A, 170B in this manner, and winding the battery coil as illustrated by Oh-144, the two tapes 170A, 170B would be disposed on opposite inner and outer surfaces of the positive plate such that a winding end of the negative plate is located between the two tapes and the two tapes extend over the winding end, as shown above. Applying the tapes 170A, 170B to on opposite surfaces of the positive plate in this manner in the Sato-Takemura-Kobayashi-Oh-539 battery would have simply been applying additional

tapes at known locations for the known benefit of improving short-circuit resistance.

348. Thus, the Sato, Takemura, Kobayashi, Oh-539, and Oh-144 combination renders claim 21 obvious.

## XV. GROUND 7: CLAIMS 1-3, 9-11, AND 17 WOULD HAVE BEEN OBVIOUS IN VIEW OF TAKEMURA IN COMBINATION WITH OH-539 AND KOBAYASHI

### A. Japanese Patent Pub. No. JP 2006-067907 to Takemura et al. (Takemura)

349. Takemura discloses a lithium-ion battery as I discussed above in Section IX.B.

### B. U.S. Patent Pub. No. 2011/0104539 to Oh et al. (Oh-539)

350. Oh-539 discloses a lithium-ion battery as I discussed above in Section XI.A.

### C. Japanese Patent Pub. No. JP 2010-055906 to Kobayashi et al. (Kobayashi)

351. Kobayashi discloses a lithium-ion battery as I discussed above in Section XII.C.

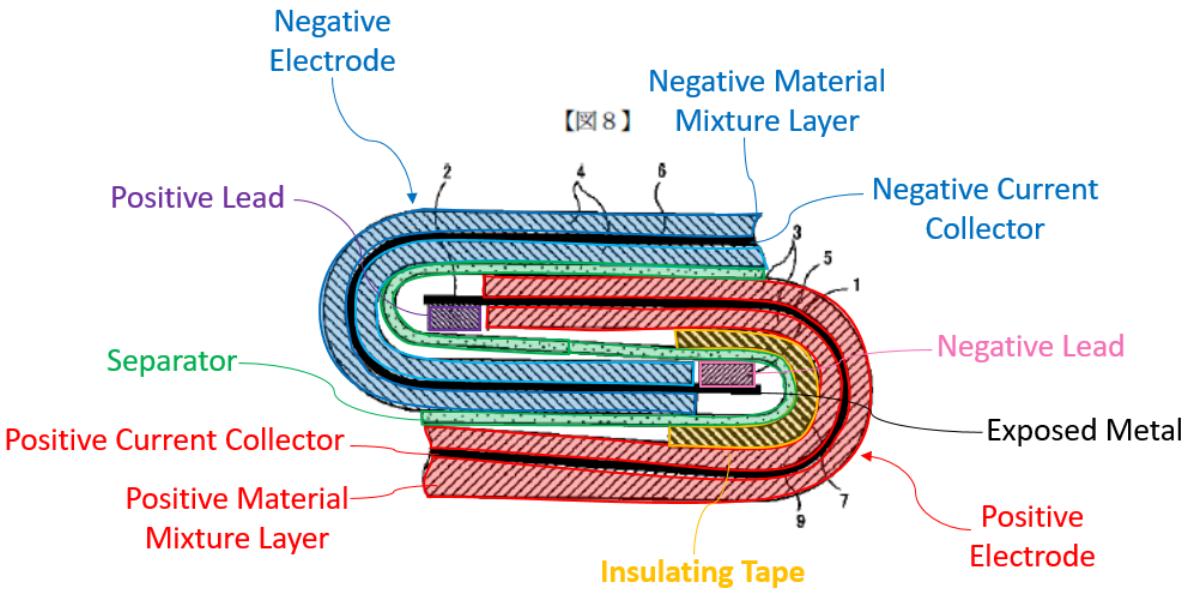
### D. A POSA would have been motivated to combine Takemura, Oh-539, and Kobayashi with a reasonable expectation of success

352. Takemura, Oh-539, and Kobayashi are analogous art as they all disclose coiled lithium-ion battery cells. EX1006, ¶[0001]; EX1007, ¶¶[0007], [0029]; EX1008, ¶¶ [0014]-[0016]. Each includes the same building blocks—

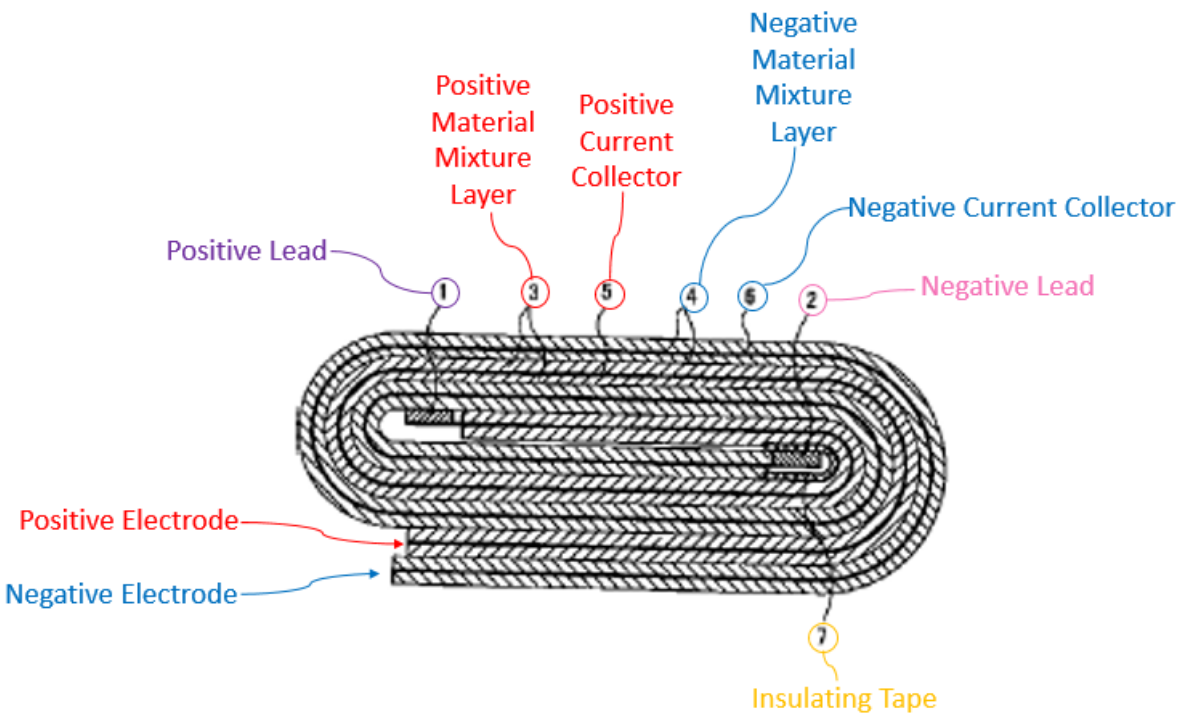
positive/negative electrode plates coated with positive/negative active material, respectively, and positive/negative leads attached to the respective positive/negative electrode plate's exposed portion. EX1006, ¶[0005]; EX1007, ¶¶[0039], [0043]; EX1008, ¶¶[0007], [0034].

**1. Motivation to combine Takemura and Oh-539**

353. As shown below in Figures 8 and 9, Takemura discloses attaching leads 2 and 3 at the ends of positive and negative electrodes.




EX1006, FIG. 8 (annotated).




EX1006, FIG. 9 (annotated).

354. Oh-539 teaches locating the positive and negative leads in centrally-located recesses formed in the positive and negative electrode active material layers. EX1007, ¶[0025]-[0026], [0045], [0051], [0058], [0061], FIGs. 2-3. Oh-539 specifically discloses this improves the battery's high-rate discharging capacity and reliability. EX1007, ¶¶[0007], [0009]-[0010], [0100]-[0105], FIGs. 8-11. What is more, these advantages were well known before January 2014. EX1015, ¶[0024] ("[b]y connecting a current collecting lead to the center exposed portion, the electric resistance of the electrode that is connected to the current collecting lead can be reduced.") A POSA would have recognized that Oh-539's placement of leads in centrally-located recesses allows the battery to "offer high output power."

EX1015, ¶[0024].

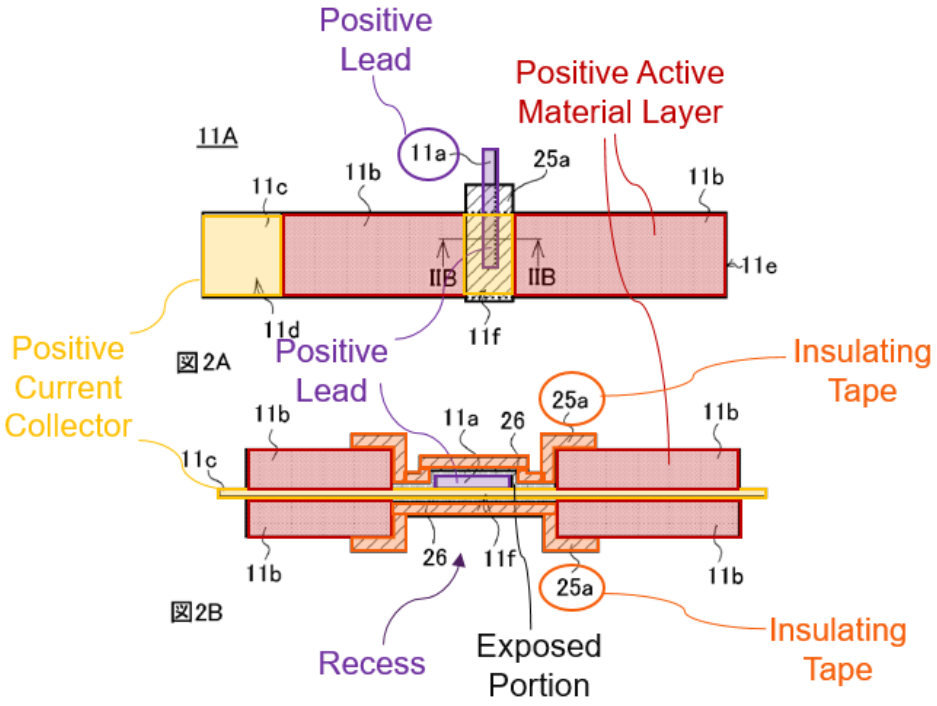
355. A POSA, therefore, would have been motivated to move Takemura's positive and negative leads to recesses formed in the positive and negative electrode active material layers, as taught by Oh-539, to improve Takemura's high power performance. EX1007, ¶¶[0007], [0009]-[0010], [0100]-[0105]. This would have reduced the length of current travel within the battery, compared to locating the leads at the end of Takemura's positive and negative current collectors. EX1007, ¶[0009]; EX1015, ¶[0024]. Reducing the distance of current flow allows the battery to output higher current and redcues resistive heating. EX1007, ¶[0049]. Moving Takemura's leads into recesses as disclosed by Oh-539 would simply have been applying a known technique—placing leads within central recesses—to a known device—Takemura's battery—yielding the predictable result of improving the battery's high-rate discharge characteristics and reliability. EX1007, ¶¶[0100]-[0105].

356. A POSA would also have had a reasonable expectation of success combining the teachings of Takemura and Oh-539. Combining the teachings of Oh-539's lead connection placements with Takemura would not have changed the intended purpose of Takemura's leads—establishing a current path from the current collector to the battery's terminal. Like all conventional leads, Takemura's leads carry current to and from the positive electrode and negative electrode.

EX1006, ¶[0007]. Similarly, Oh-539's leads in recesses carry current to and from the positive and negative electrodes. EX1007, ¶¶[0049], [0060]. Further, both Takemura and Oh-539 disclose that the leads can be attached by welding. EX1006, ¶[0007]; EX1007, ¶¶[0046], [0059]. So, moving Takemura's leads into recesses would simply entail repositioning the leads and attaching the leads using known techniques.

**2. Motivation to combine Kobayashi with Takemura-Oh '-539**

357. In combining the teachings of Oh-539's recesses with Takemura, POSA would have been motivated to cover the positive electrode lead, and any exposed metal around it, with insulating tapes in view of Kobayashi. Kobayashi teaches that the positive lead connection, the exposed metal on and around the positive lead, and edges of positive active material at the recess are areas where pressure points and burrs are likely to cause short-circuits to the anodes. EX1008, ¶¶[0005], [0014]. To cure this problem, Kobayashi affixed insulating tape "at potential short-circuit locations where such short-circuits can be expected to occur in order to prevent short-circuits due to contact with the opposing electrode at potential short-circuit locations." EX1008, ¶[0005].




EX1008, FIGs. 2A-2B (annotated).

358. Thus, a POSA would have been motivated to apply insulating tape to the positive lead and associated recess in the Takemura-Oh-539 battery. A POSA would have understood that adding insulating tape(s) as disclosed by Kobayashi would protect Takemura-Oh-539's positive lead, exposed metal, and edges of positive active material at the recess. EX1008, ¶¶[0005], [0014]. This modification would have simply been combining a known component (Kobayashi's insulating tape) to a known device (Takemura-Oh-539 battery) at a known location, yielding predictable results of preventing short-circuiting and improving battery reliability.

359. A POSA would also have had a reasonable expectation of success combining the teachings of Takemura and Oh-539 with Kobayashi because

Takemura's leads, as modified by Oh-539 and Kobayashi, would still have achieved its intended function of establishing a current path from the current collector to the battery's terminal. Insulating tapes were common in coiled lithium-ion battery cells well before 2014. *See* EX1006, ¶¶3, 8, 22; see also EX1009, ¶8; EX1010, ¶29; EX1011, ¶18. What is more, insulating tapes were specifically known to help prevent short-circuiting at the leads in coiled lithium-ion batteries. EX1011, ¶¶[0014], [0033]-[0034]; EX1012, ¶¶[0037]-[0038]; EX1017, ¶¶[0037]-[0038]. A POSA would have expected Kobayashi's insulating tape, incorporated into the Takemura-Oh-539 battery to perform its intended function of insulating exposed metal and the edges of the positive coating to prevent short-circuiting. Combining Kobayashi's insulating tape with the Takemura-Oh-539 battery would have amounted to nothing more than applying Kobayashi's tape to the Takemura-Oh-539 battery at a known position for a known benefit.

### E. The combination of Takemura, Oh-539, and Kobayashi discloses or renders obvious every element of claims 1-3, 9-11, and 17.

360. The following explains how each claimed element of the '498 patent is disclosed by Takemura, Oh-539, and/or Kobayashi. In view of Takemura's, Oh-539's and Kobayashi's disclosures, a POSA would have modified Takemura in view of Oh-539 and Kobayashi to arrive lithium-ion batteries as claimed in the '498 patent.

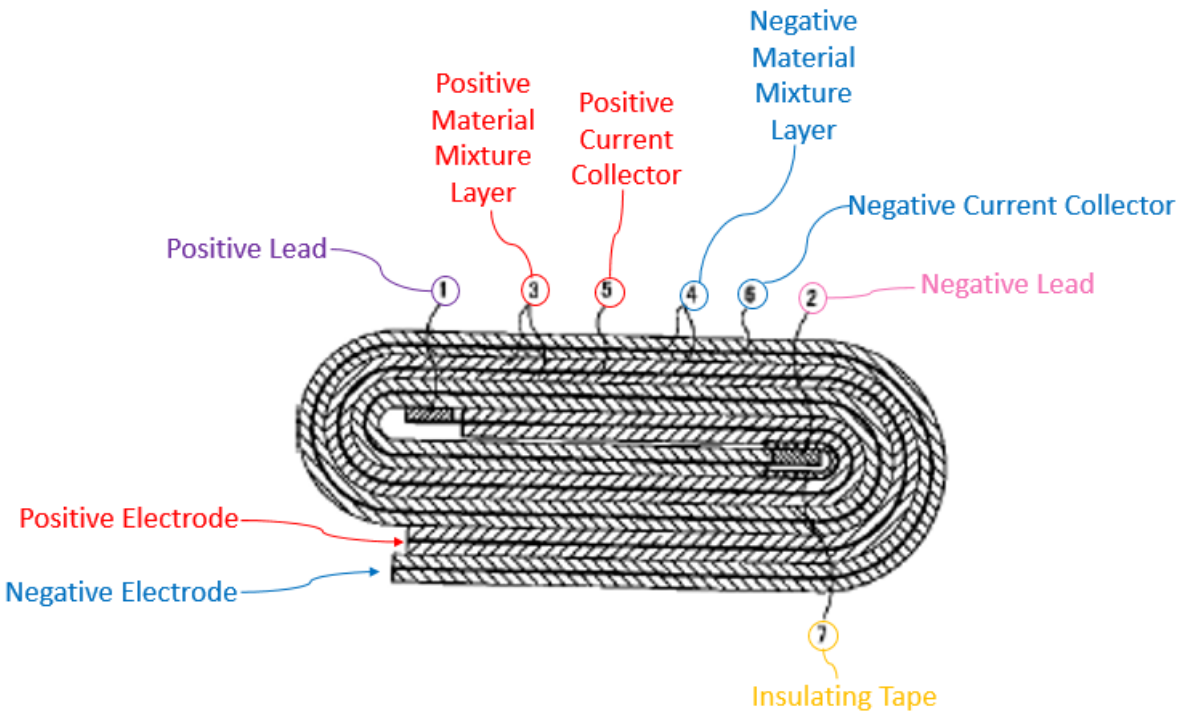
**1. [1.P] "A lithium-ion battery, comprising:"**

361. Takemura discloses a lithium-ion battery. EX1006, ¶[0003]. In particular, Takemura discloses a conventional a lithium-ion battery shown in FIGs. 8 and 9, which is used as a comparative example in Takemura's disclosure. EX1006, ¶¶[0003], [0035].

362. Accordingly, a POSA would have understood that Takemura discloses a lithium-ion battery.

**2. [1.A] "a positive electrode comprising a positive current collector and a positive electrode active material layer containing $LiCoO_2$, wherein the positive electrode active material layer is formed on the positive current collector,"**

363. Takemura discloses a positive electrode with a positive current collector 5 and a positive electrode active material layer 3 formed on the positive current collector 5, as shown below in Figures 8 and 9. EX1006, ¶[0003] and FIGs. 8 and 9.




EX1006, FIG. 9 (annotated).

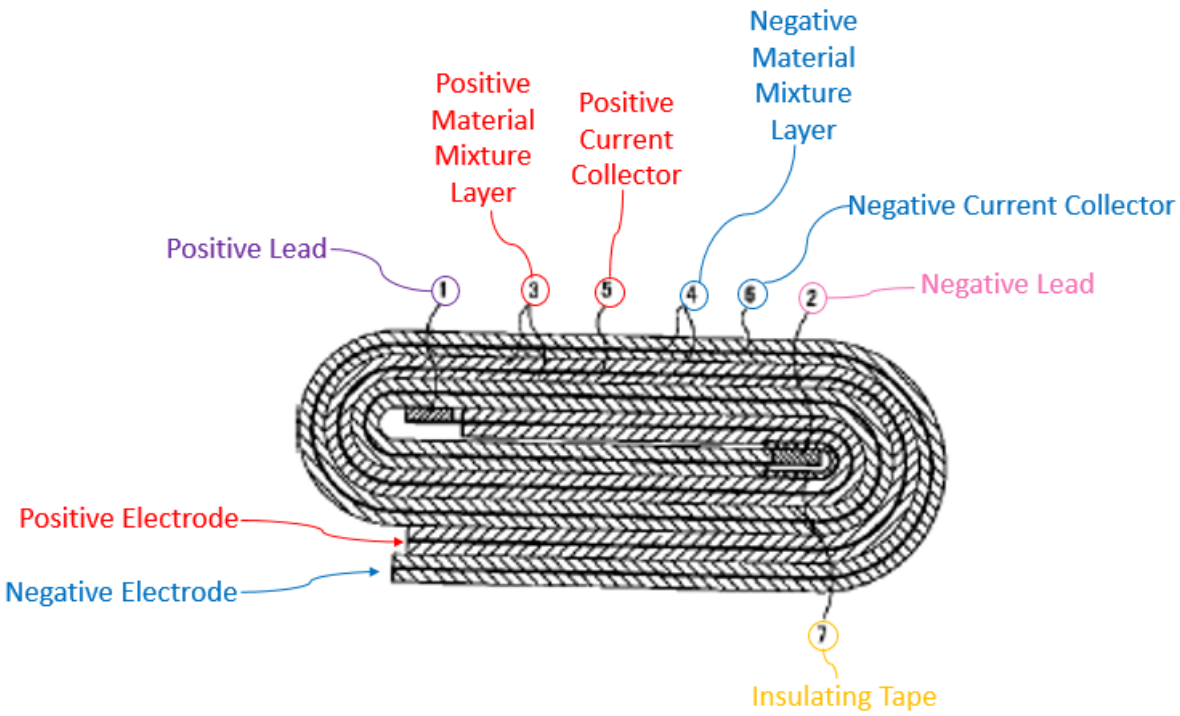
364. Takemura also discloses that the positive electrode active material layer 3 can comprise $LiCoO_2$. EX1006, ¶¶ [0025] ("positive electrode active material consisting of $LiCoO_2$"), [0031]. Paragraph [0031] explains that the comparative example was formed of the same materials as example 1 in paragraph [0025].

365. Accordingly, a POSA would have understood that Takemura discloses Element [1.A].

**3. [1.B] the positive electrode active material layer being provided with a first recess accommodating a positive lead being coupled with the positive current collector;**

**a. Takemura**

366. Takemura discloses that the positive electrode active material layer 3 is provided with a bare, exposed portion at the end of the positive current collector 5 that accommodates a positive lead 1 coupled with the positive current collector 5. EX1006, ¶[0003] and FIGs. 8 and 9.

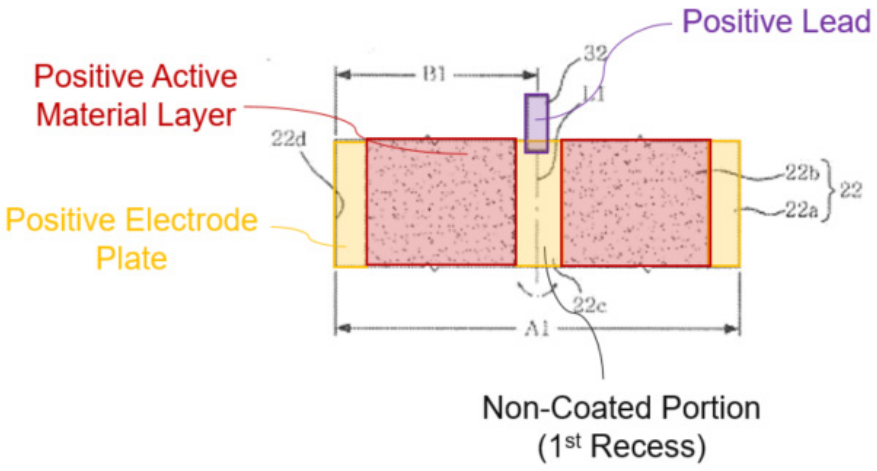



EX1006, FIG. 9 (annotated).

367. For the conventional battery shown in FIGs. 8 and 9, Takemura does not disclose a first recess in the positive active material layer 3 for accommodating the positive lead 1 coupled to the positive current collector 5.

**b. Oh-539**

368. Oh-539 discloses placing a positive lead (cathode tab 32) within a first recess (non-coated portion 22c) formed in the positive active material (cathode active material 22b) on a positive electrode 22 for a lithium-ion battery. EX1007, ¶¶[0039]-[0046] and FIG. 2. The center of Oh-539's first recess (non-coated portion 22c) is located at distance B1 that is 40% to 60% of the total length A1 of Oh-539's positive electrode 22. EX1007, ¶¶[0050]-[0051].




EX1007, FIG. 2 (annotated).

369. According to Oh-539, placing the positive lead (cathode tab 32) within a recess centered at 40% to 60% of the total length of a positive electrode reduces the length that current must travel within the battery, compared to battery having the positive lead located at or near the end of positive electrode. EX1007, ¶¶[0007], [0009]-[0010]. And by reducing the distance the current must travel, Oh-539 explains that various characteristics of the lithium-ion battery can be improved

such that the battery can be used in "places where a battery requiring high power is needed because its high-rate discharging characteristics can be improved, and its reliability can be improved by minimizing the exothermic phenomenon generated by the movement of electric current." EX1007, ¶[0009]. Oh-539 substantiates these benefits in the comparative data reported in Figures 8-11 and discussed in paragraphs [0100]-[0105].

**c. Combination of Takemura and Oh-539**

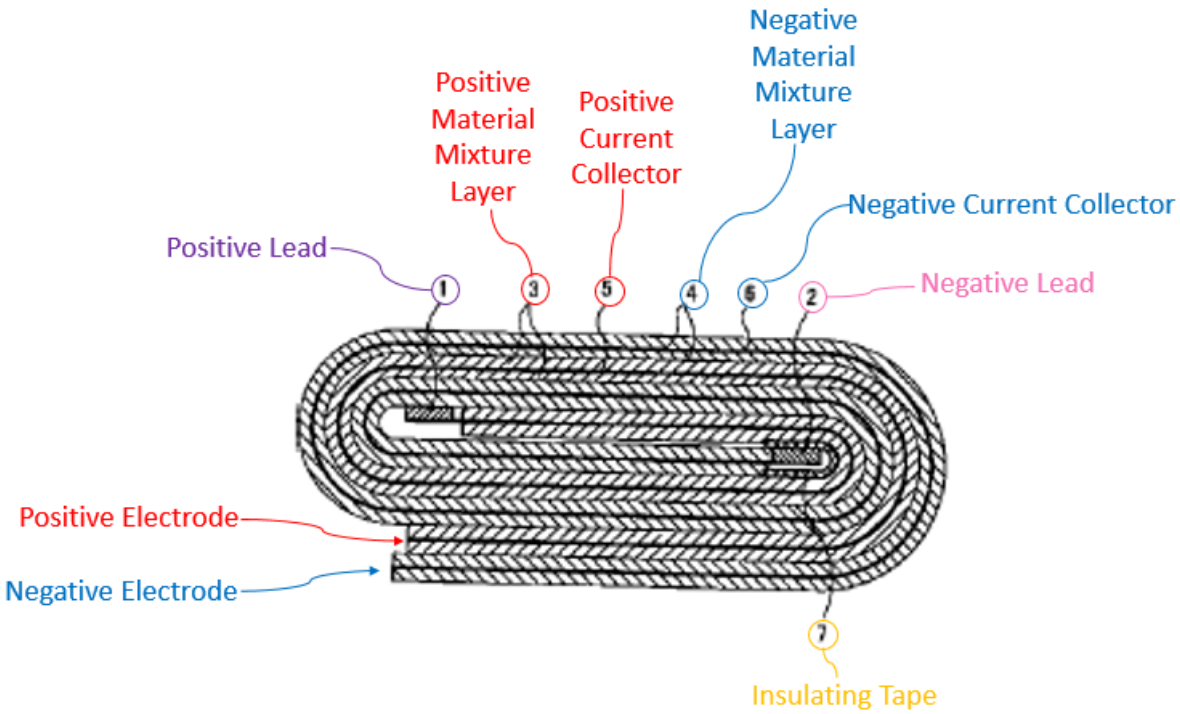
370. In view of Takemura's and Oh-539's disclosures, it would have been obvious to a POSA to move Takemura's positive lead 1 into a recess formed in the positive electrode active material layer 3 and centered at 40% to 60% of the total length of the positive current collector 5. This modification would have reduced the reduce the length of current travel within the battery, compared to the location of lead 1 at the end of Takemura's positive current collector. EX1007, ¶[0009]. As explained by Oh-539, centrally locating the lead connection on the current collector would have provided at least the following benefits to Takemura's battery: improved high power characteristics, improved high-rate discharging characteristics, and improved reliability. EX1007, ¶¶ [0007], [0009]-[0010], and [0100]-[0105].

371. Accordingly, a POSA would have understood that the combined disclosures of Takemura and Oh-539 render Element [1.B] obvious.

**4. [1.C] "a negative electrode comprising a negative current collector and a negative electrode active material layer containing graphite or silicon, wherein the negative electrode active material layer is formed on the negative current collector,"**

**a. Takemura**

372. Takemura discloses a negative electrode comprising a negative current collector 6 and a negative electrode active material layer 4 formed on the negative current collector 6, as shown below in Figures 8 and 9. EX1006, ¶[0003] and FIGs. 8 and 9.




EX1006, FIG. 9 (annotated).

373. Takemura also discloses that the negative electrode active material layer 4 can comprise a carbon-based material, such as mesophase carbon

microbeads. EX1006, ¶¶ [0026], [0031]. Paragraph [0031] explains that the comparative example was formed of the same materials as example 1 in paragraph [0026]. A POSA would have understood that Takemura's mesophase carbon microbeads are a specific form of graphite commonly used in the active material layer of an anode. *See* EX1020, 380 ("glass cells containing spiral rolls of mesocarbon microbead (MCMB) 1028 graphite anodes").

**b. Oh-539**

374. To the extent that Takemura does not explicitly disclose a negative active material including graphite, Oh-539 discloses forming a negative electrode active material layer from graphite was well known. Specifically, Oh-539 discloses that the negative electrode active material layer (anode active material 24b) in a lithium-ion battery can comprise natural graphite. EX1007, ¶¶[0088], [0096]. Oh-539 pairs the negative active material layer comprising graphite with a positive electrode active material layer (cathode active material 22b) comprising $LiCoO_2$. EX1007, ¶¶[0084], [0093]. Accordingly, a POSA would have recognized that Oh-539's natural graphite of the negative active material would have intercalated lithium ions released from positive active material of Takemura's positive electrode.

**c. Combination of Takemura and Oh-539**

375. In view of Takemura's and Oh-539's disclosures, it would have been

obvious to a POSA to employ a negative active material layer including graphite in Takemura's battery. Graphite was a known material for use in negative active material layers within lithium-ion batteries. EX1007, ¶¶[0088], [0096]; EX1008, ¶[0017]. Further, graphite was also known for use in negative active material layers paired with positive active material layers comprising $LiCoO_2$—the same material in Takemura's positive active material layer. EX1007, ¶¶[0084], [0093]; EX1008, ¶¶[0016]-[0017]; EX1015, ¶¶[0051]-[0053].

376. Substituting graphite for all or a portion of Takemura's mesophase carbon microbeads as disclosed by Oh-539 would have simply been substituting one known negative active material for another known negative active material, yielding the predictable result of forming a negative electrode that intercalates lithium ions.

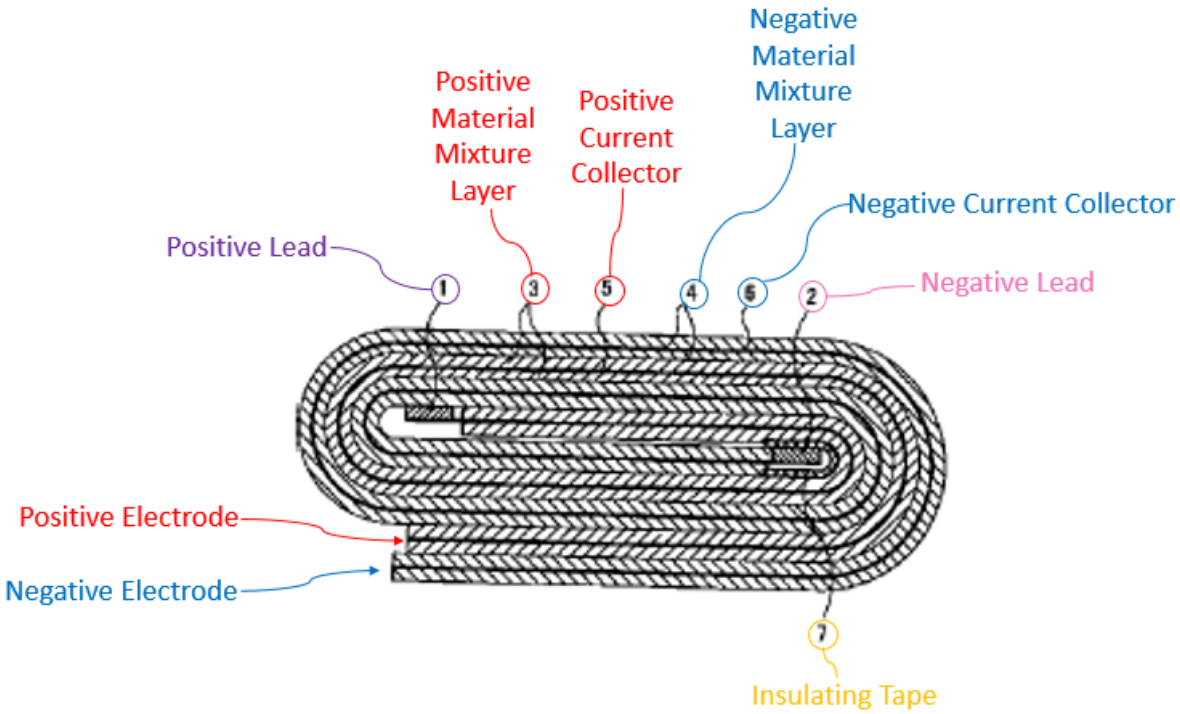
377. Accordingly, a POSA would have understood that the combined disclosures of Takemura and Oh-539 render Element [1.C] obvious.

**5. [1.D] "the negative electrode active material layer being provided with a second recess accommodating a negative lead being coupled with the negative current collector;"**

**a. Takemura**

378. Takemura discloses that the negative electrode active material layer 4 is provided with a bare, exposed portion at the end of the negative current collector 5 that accommodates a negative lead 2 coupled with the negative current collector

(6). EX1006, ¶[0003] and FIGs. 8 and 9.



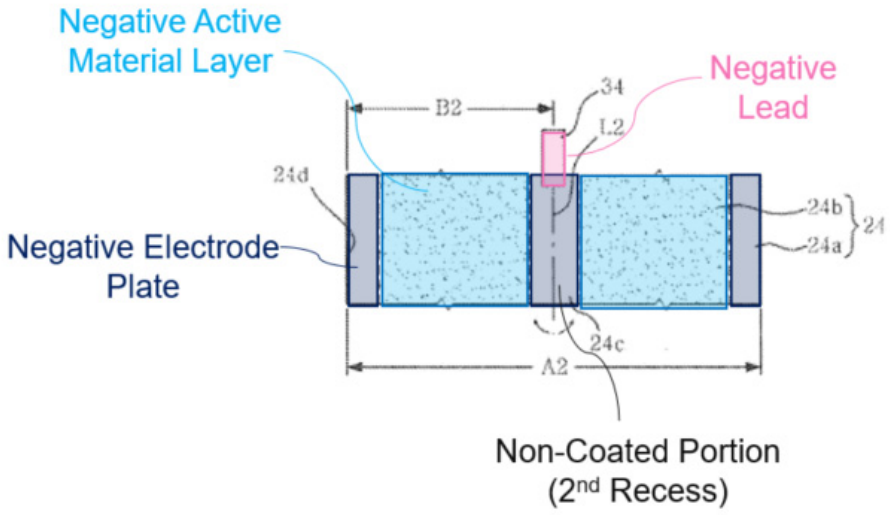

EX1006, FIG. 9 (annotated).

379. For the conventional battery shown in FIGs. 8 and 9, Takemura does not disclose a second recess in the negative active material layer 4 for accommodating the negative lead 2 coupled to the negative current collector 6.

**b. Oh-539**

380. Oh-539 discloses placing a negative lead (anode tab 34) within a recess (non-coated portion 24c) formed in the negative active material (anode active material 24b) on a negative electrode 24 for a lithium-ion battery. EX1007, ¶¶[0056]-[0059] and FIG. 3. The center of Oh-539's recess (non-coated portion 24c) is located at distance B1 that is 40% to 60% of the total length A1 of Oh-

539's negative electrode 24. EX1007, ¶¶[0061]-[0062].




EX1007, FIG. 3 (annotated).

381. According to Oh-539, placing the negative lead (cathode tab 34) within a recess centered at 40% to 60% of the total length of a negative electrode reduces the length that current must travel within the battery, compared to battery having the negative lead located at or near the end of negative electrode. EX1007, ¶¶[0007], [0009]-[0010]. And by reducing the distance the current must travel, Oh-539 explains that various characteristics of the lithium-ion battery can be improved such that the battery can be used in "places where a battery requiring high power is needed because its high-rate discharging characteristics can be improved, and its reliability can be improved by minimizing the exothermic phenomenon generated by the movement of electric current." EX1007, ¶[0009]. Oh-539 substantiates these benefits in the comparative data reported in Figures 8-11 and discussed in

paragraphs [0100]-[0105].

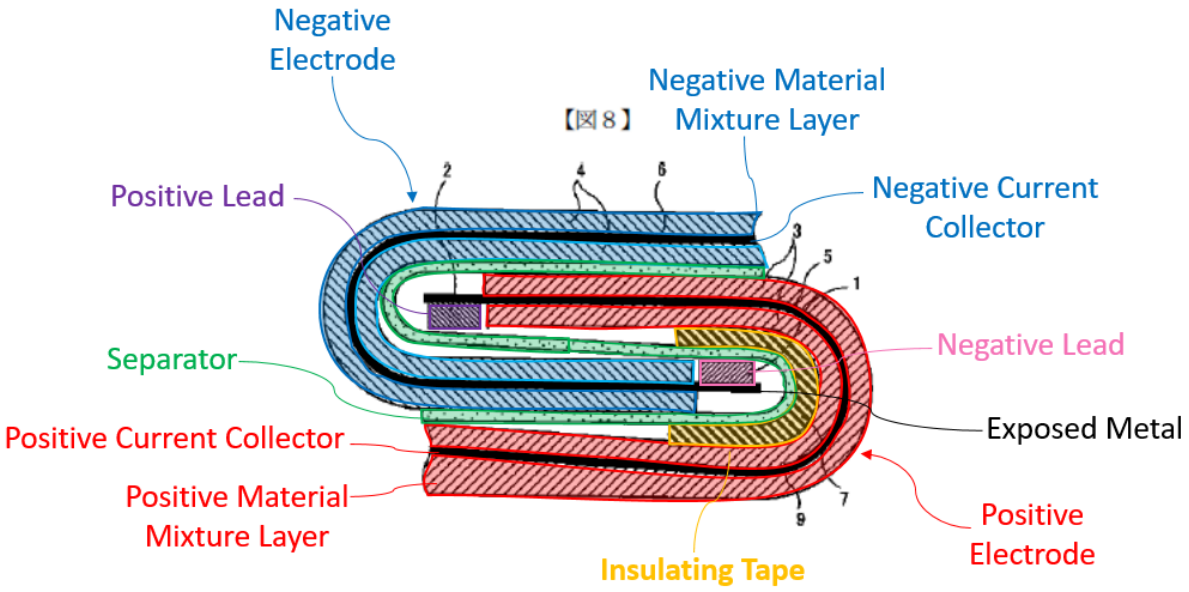
**c. Combination of Takemura and Oh-539**

382. In view of Takemura's and Oh-539's disclosures, it would have been obvious to a POSA to move Takemura's negative lead 2 into a recess formed in the negative electrode active material layer 5 and centered at 40% to 60% of the total length of the negative current collector 6. This move would have reduced the the length of current travel within the battery, compared to the location of lead 2 at the end of Takemura's negative current collector. EX1007, ¶[0009]. As explained by Oh-539 this would have provided at least the following benefits to Takemura's battery: improved high power characteristics, improved high-rate discharging characteristics, and improved reliability. EX1007, ¶¶ [0007], [0009]-[0010], and [0100]-[0105].

383. Accordingly, a POSA would have understood that the combined disclosures of Takemura and Oh-539 render Element [1.D] obvious.

**6. [1.E] "a separator disposed between the positive electrode and the negative electrode; and"**

384. Takemura discloses a separator disposed between the positive electrode and the negative electrode. EX1006, ¶[0003] and FIG 8.




EX1006, FIG. 8 (annotated).

385. Accordingly, a POSA would have understood that Takemura discloses Element [1.E].

**7. [1.F] "an electrolyte,"**

386. Takemura discloses an electrolyte. EX1006, ¶[0003]. Takemura's electrolyte is impregnated within the separator. EX1006, ¶[0003].

387. Accordingly, a POSA would have understood that Takemura discloses Element [1.F].

**8. [1.G] "wherein, a top surface of the positive lead is provided with a first insulating glue layer,"**

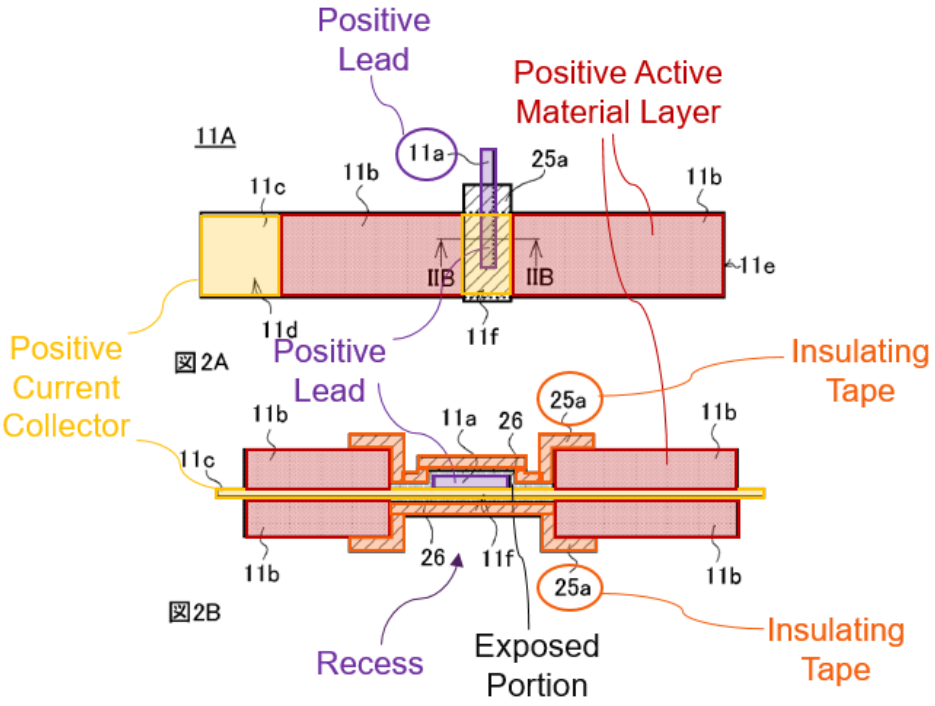
**a. Takemura and Oh-539**

388. As discussed above for element [1.B], Takemura combined with Oh-539 teaches a lithium-ion battery with a positive lead coupled to the positive current collector in a first recess formed in the positive active material layer.

Takemura and Oh-539 do not specifically disclose providing a first insulating glue layer on a top surface of the positive lead. But placing an insulating tape on the top surface of the positive lead would have been obvious in view of Kobayashi.

**b. Kobayashi**

389. As shown below in Figures 2A and 2B, Kobayashi discloses tapes 25a on both the top and bottom surface of the exposed portion 11f of the positive electrode plate 11A. EX1008, ¶¶ [0034]-[0035]. A first piece of tape 25a is placed on the top surface covering the positive current collecting tab 11a and edges of the positive active material 11b adjacent the positive current collecting tab 11a. EX1008, ¶¶ [0034]-[0035]. Similarly, a second piece of tape 25a is placed on the bottom surface covering exposed metal foil opposite the positive current collecting tab 11a and edges of the positive active material 11b on the bottom surface. EX1008, ¶¶ [0034]-[0035].




EX1008, FIGs. 2A and 2B (annotated).

390. Kobayashi's tapes 25a covered the positive current collecting tab 11a and exposed metal foil within exposed portion 11f to prevent short circuits from occurring at the exposed portion 11f. EX1008, ¶[0005], [0010], [0014]. In particular, Kobayashi's tapes 25a are intended to prevent short circuits caused by pressure points and burrs, which are likely at coating step edges and where the tab is attached. EX1008, ¶[0005], [0010], [0014]. It is my understanding that Patent Owner equates insulating glue layers to adhesive tapes in the related district court complaint. EX1024, 8, 27, 28. Under Patent Owner's position, Kobayashi's insulating tape 25a with glue layer 26 is an insulating glue layer.

**c. Combination of Takemura, Oh-539, and Kobayashi**

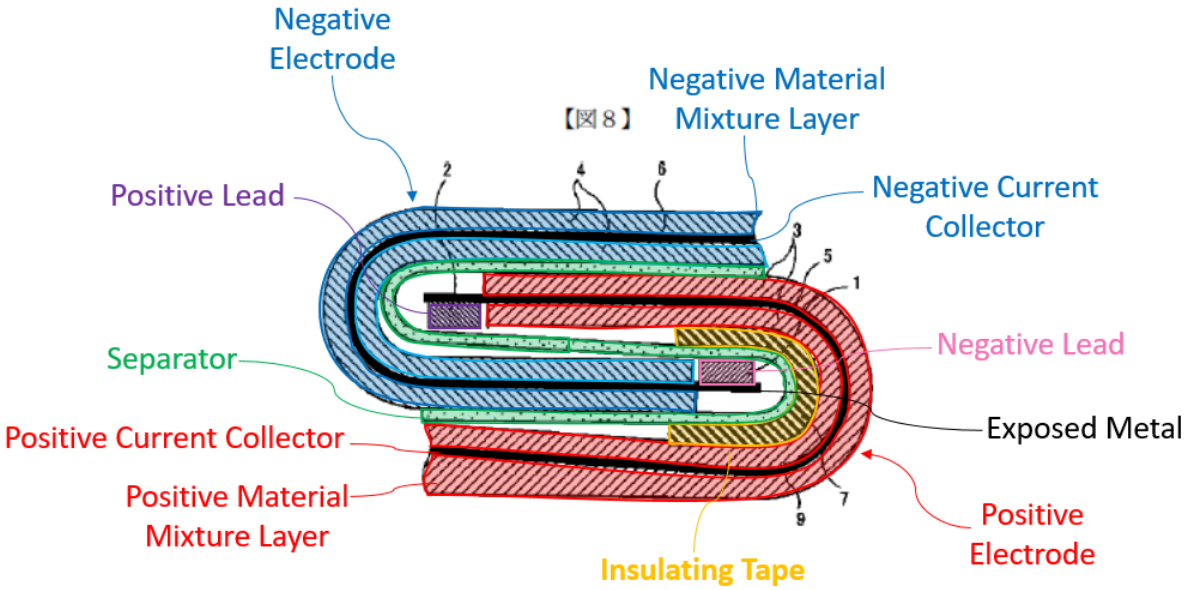
391. In view of Takemura's, Oh-539's, and Kobayashi's disclosures, it would have been obvious to a POSA to apply Kobayashi's first piece of tape 25a on the top surface of the positive lead positioned within the first recess in the Takemura-Oh-539 battery. Based on at least Kobayashi's disclosure, a POSA would have understood that the exposed metal and edges of positive active material on both the top side of the positive current collector in the Takemura-Oh-539 battery are susceptible short-circuiting. EX1008, ¶[0014]. Applying Kobayashi's tape 25a to the top surface of the positive lead in the Takemura-Oh-539 battery would have amounted to nothing more than applying a tape to the Takemura-Oh-539 battery at a known location and for a known benefit.

392. Accordingly, the combined disclosures of Takemura, Oh-539, and Kobayashi render element [1.G] obvious.

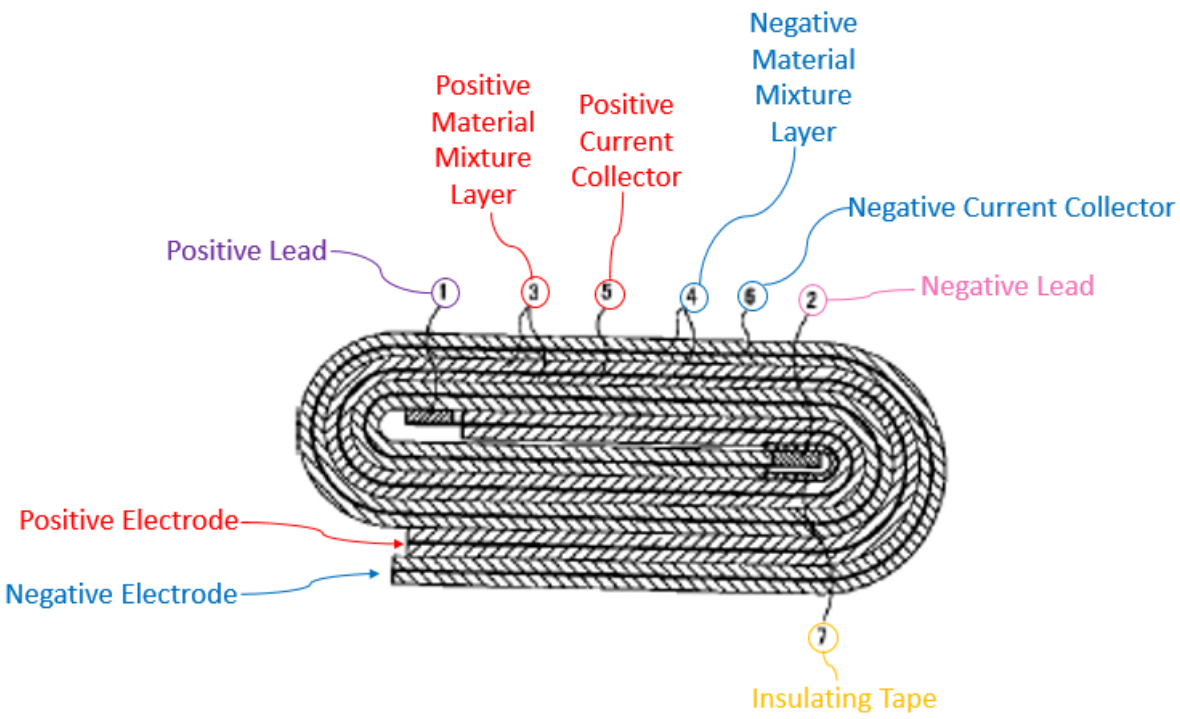
**9. [1.H] "a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer,"**

393. As discussed for [1.D], Takemura-Oh-539 teaches forming a second recess in the negative active material layer to accommodate a lead connected to the negative current collector. As discussed in Section IX.D.9.b, Takemura discloses attaching an insulating tape 7 to the positive active material layer 3 opposite both sides of the bare negative electrode current collector 6 where the negative lead 1 is

attached. EX1006, ¶[0008], FIGs. 8-9. The location of Takemura's insulating tape 7 in Figures 8 and 9 corresponds to the position of the claimed "second insulating tape" because Takemura's tape 7 is located on a surface of a positive active material layer and opposite a negative lead connection.

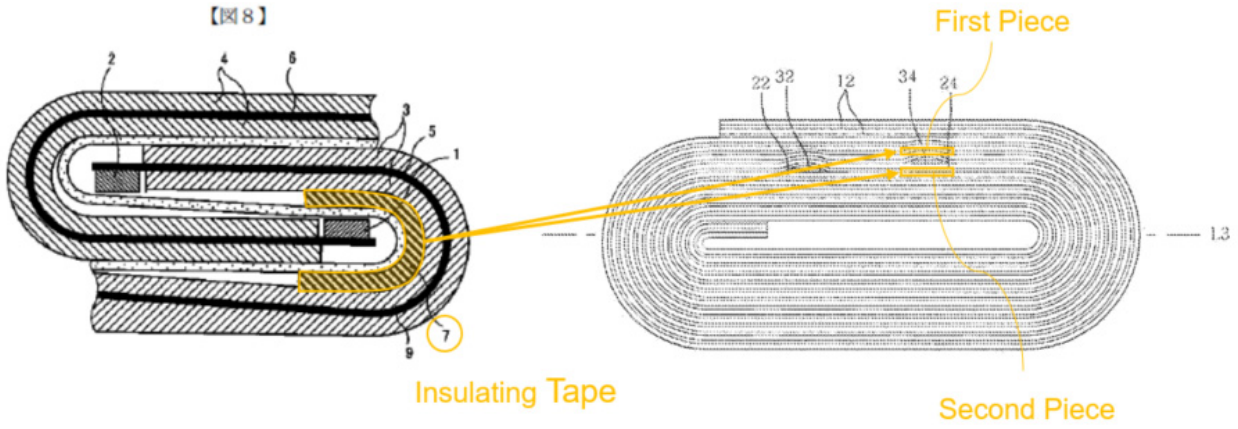



EX1006, FIG. 8 (annotated).




EX1006, FIG. 9 (annotated).

394. In combining Oh-539's central placement of the negative lead connection with Takemura, a POSA would have rearranged Takemura's tape 7 on the surface of positive active material layer 3 to be placed opposite both sides of the exposed anode foil where the negative lead is attached to shield it from lithium plating. Specifically, a POSA would have placed Takemura's tape 7 on the positive material layer surface opposite the second recess of the Takemura-Oh-539 battery. The following annotated images of Takemura's Figure 8 and Oh-539's Figure 4 illustrate how a POSA would have applied Takemura's insulating tape 7 to the surface of the positive electrode active material layer 3 after moving the negative lead into a centrally located recess.




EX1006, FIG. 8 and EX1007, FIG. 4 (annotated).

395. To prevent lithium plating at the exposed metal located on the top and bottom side of the second recess in the Takemura-Oh-539 battery, a POSA would have been motivated to divide Takemura's insulating tape 7, which is bent around top and bottom sides at an end of the electrode, into two pieces as shown above. The two pieces would be located at the second location as recited in element [1.H] of the '498 patent—namely on a surface of the positive electrode active material layer across the separator from the second recess, with the first piece above and the second piece below the second recess.

396. Accordingly, the combined disclosures of Takemura, Oh-539, and Kobayashi render element [1.H] obvious.

**10. [1.I] "the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of the second recess."**

397. For the same discussed in Section IX.D.10.b, Takemura discloses an

insulating tape 7 having a width (measured along the length of the negative electrode in the cross-section shown in Figures 8-9) greater than the exposed metal on the negative electrode current collector 6. In combining Oh-539's central placement of the negative lead connection with Takemura, a POSA would have kept the width of Takemura's insulating tape 7 greater than the width of the second recess formed in the negative active material 4 of Takemura's negative electrode so that all exposed metal is covered by insulating tape 7.

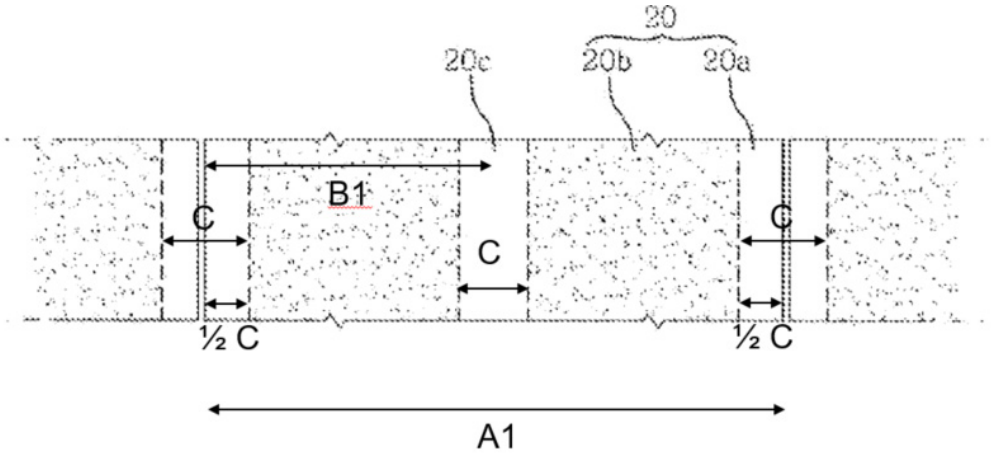
398. Takemura does not explicitly disclose that the insulating tape 7 has a length larger than the length of the exposed metal on the negative electrode current collector 6. That said, a POSA would have understood, or at least found it obvious, to make the length of Takemura's tape 7 (measured along the width of the electrode) larger than the length of the current collector's exposed surface in the Takemura-Oh-539 battery to avoid exposing metal on the negative electrode to lithium plating. Sizing the tape to have a length larger than the length of the exposed metal would have helped ensure that metal is not exposed as result of alignment variances. EX1022, 51 (explaining that "an underlapped condition [i.e., exposed metal on the negative electrode] may occur in some region of a cell, if dimensional and alignment tolerances are not adequately managed.").

**11. 2. "The lithium-ion battery of claim 1, wherein a distance between a center of the first recess and one end of the positive electrode active material layer is ¼-¾ of a length of the positive electrode active material layer; and a distance**

**between a center of the second recess and one end of the negative electrode active material layer is ¼-¾ of a length of the negative electrode active material layer."**

399. The Takemura-Oh-539-Kobayashi combination renders obvious the recited locations of the first and second recesses in the length direction of the positive and negative electrodes.

400. With the Takemura-Oh-539-Kobayashi combination, Oh-539 discloses that each cathode 22 includes a centrally located recess (non-coated portion 20c) having a length "C" and two non-coated portions 20C located at opposing ends of the cathode 22 having a length "½ C." Further, Oh-539 teaches that the recess (centrally-located non-coated portion 22c) is located at distance B1, 40% to 60% of the total length A1 of Oh-539's positive electrode 22. EX1007, ¶¶[0050]-[0051]. Given the symmetrical, repeated nature of Oh-539's cathode 22, a distance between a center of the centrally-located non-coated portion 22C and one end of the positive electrode active material layer (material 22b) would be 40% to 60% of the total length of the positive electrode active material layer (material 22b). This falls within the claimed range of ¼ to ¾ of a length of the positive electrode.




EX1007, FIG. 6(c) (annotated).

401. Similarly , Oh-539 discloses that each anode 22 includes a centrally located recess (non-coated portion 20c) having a length of "C" and two non-coated portions 20C located at opposing ends of the anode 24 having a length of "½ C". Further, Oh-539 teaches that the recess (centrally located non-coated portion 24c) is located at distance B1 that is 40% to 60% of the total length A1 of Oh '539's negative electrode 24. EX1007, ¶¶[0061]-[0062]. Given the symmetrical, repeated nature of Oh-539's anode 24, a distance between a center of the centrally located non-coated portion 22C and one end of the negative electrode active material layer (material 24b) would be 40% to 60% of the total length of the negative electrode active material layer (material 24b). This falls within the claimed range of ¼ to ¾ of a length of the negative electrode.

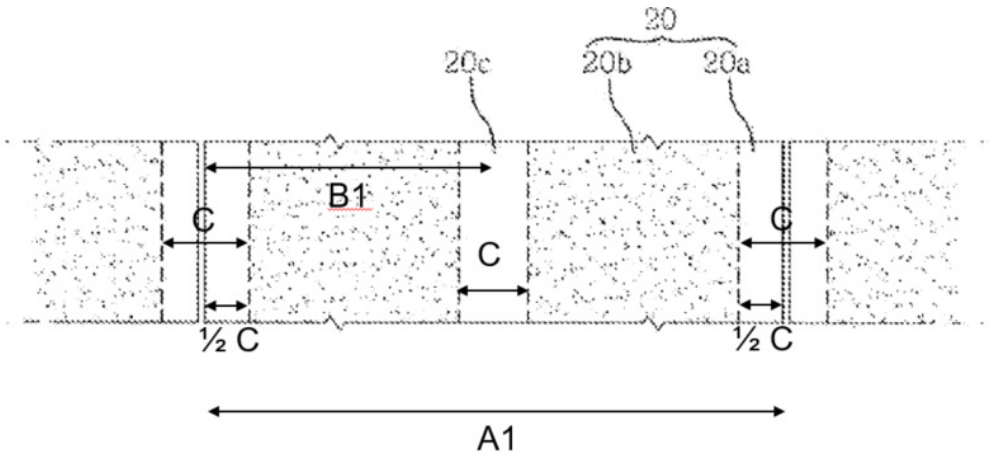
402. In combining the teachings of Oh-539's recesses and lead. connections with Takemura, a POSA would have been motivated to locate the

center of the first and second recesses at a distance from the end of the electrode by a distance corresponding to 40% to 60% of the electrode length, as taught by Oh-539, to reduce the internal current path, thereby improving the battery's high-rate discharge characteristics.

12. **3. "The lithium-ion battery of claim 2, wherein, the distance between the center of the first recess and the one end of the positive electrode active material layer is half of the length of the positive electrode active material layer; and the distance between the center of the second recess and the one end of the negative electrode active material layer is half of the length of the negative electrode active material layer."**

403. The Takemura-Oh-539-Kobayashi combination renders obvious the recited locations of the first and second recesses in the length direction of the positive and negative electrodes.

404. As discussed above for claim 2, Oh-539 discloses that the distance between the center of the centrally located non-coated portion 22C and one end of the positive electrode active material layer (material 22b) is 40% to 60% of the total length of the positive electrode active material layer (material 22b). This range includes the claimed value of ½ and is also the position of the center of the non-coated portion 20C in Fig. 6(c).




EX1007, FIG. 6(c) (annotated).

405. Similarly, Oh-539 discloses that the distance between the center of the centrally located non-coated portion 22C and one end of the negative electrode active material layer (material 24b) is 40% to 60% of the total length of the negative electrode active material layer (material 24b). This range includes the claimed value of ½.

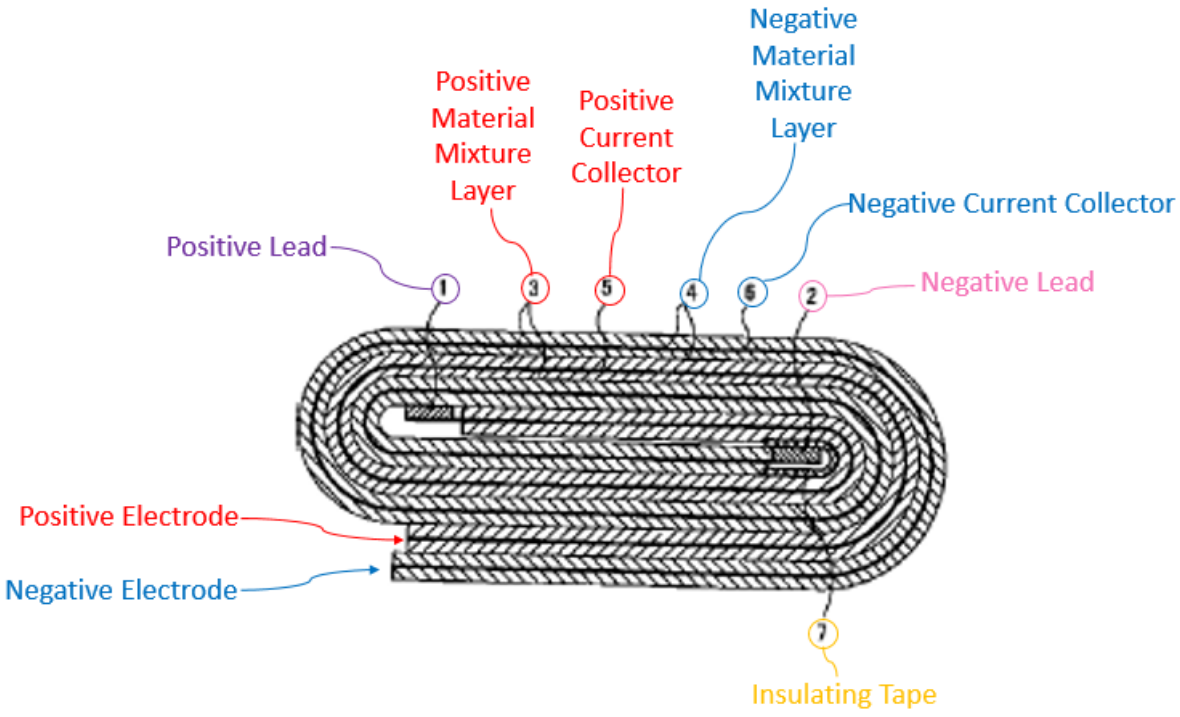
406. In combining Oh-539's recesses and lead connections with Takemura, a POSA would have been motivated to locate the center of the first and second recesses at a distance from the end of the electrode by a distance corresponding to half of the electrode length, as taught by Oh-539, to reduce the internal current path, thereby improving the battery's discharge rate.

### 13. [9.P]: "A lithium-ion battery, comprising:"

407. For the same reasons discussed above with respect to Element [1.P], Takemura discloses a lithium-ion battery. EX1006, ¶¶[0003], [0035], FIGs. 8 and 9.

**14. [9.A] "a positive electrode, comprising a positive current collector and a positive electrode active material layer being formed on the positive current collector."**

408. For the same reasons discussed above with respect to Element [1.A], Takemura discloses the recited "positive electrode" in the form of positive electrode plate shown below in Figure 9, the recited "positive current collector" in the form of a positive electrode current collector 5, and the recited "positive electrode active material layer" in the form of positive electrode material layer 3. EX1006, ¶[0003].




EX1006, FIG. 9 (annotated).

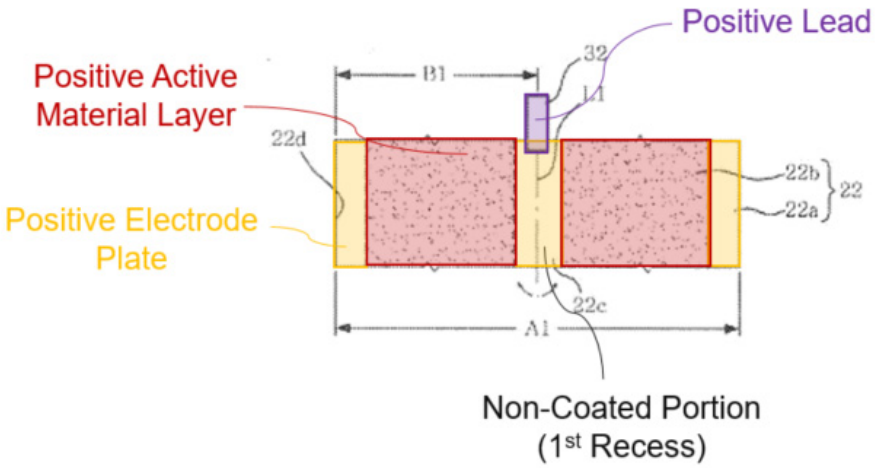
**15. [9.B] "the positive electrode active material layer being provided with a first recess accommodating a positive lead being coupled with the positive current collector"**

**a. Takemura**

409. As discussed above with respect to Element [1.B], Takemura's battery shown in Figures 8 and 9 does not include a first recess in the positive active material layer 3 for accommodating the positive lead 1 coupled to the positive current collector 5.

**b. Oh-539**

410. For the same reasons discussed above with respect to Element [1.B], Oh-539 discloses placing a positive lead (cathode tab 32) within a first recess (non-coated portion 22c) formed in the positive active material (cathode active material 22b) on a positive electrode 22 for a lithium-ion battery. EX1007, ¶¶[0039]-[0046] and FIG. 2. Oh-539 discloses placing a positive lead (cathode tab 32) within the first recess (non-coated portion 22c) coupled to a positive current collector.



EX1007, FIG. 2 (annotated).

**c. Combination of Takemura and Oh-539**

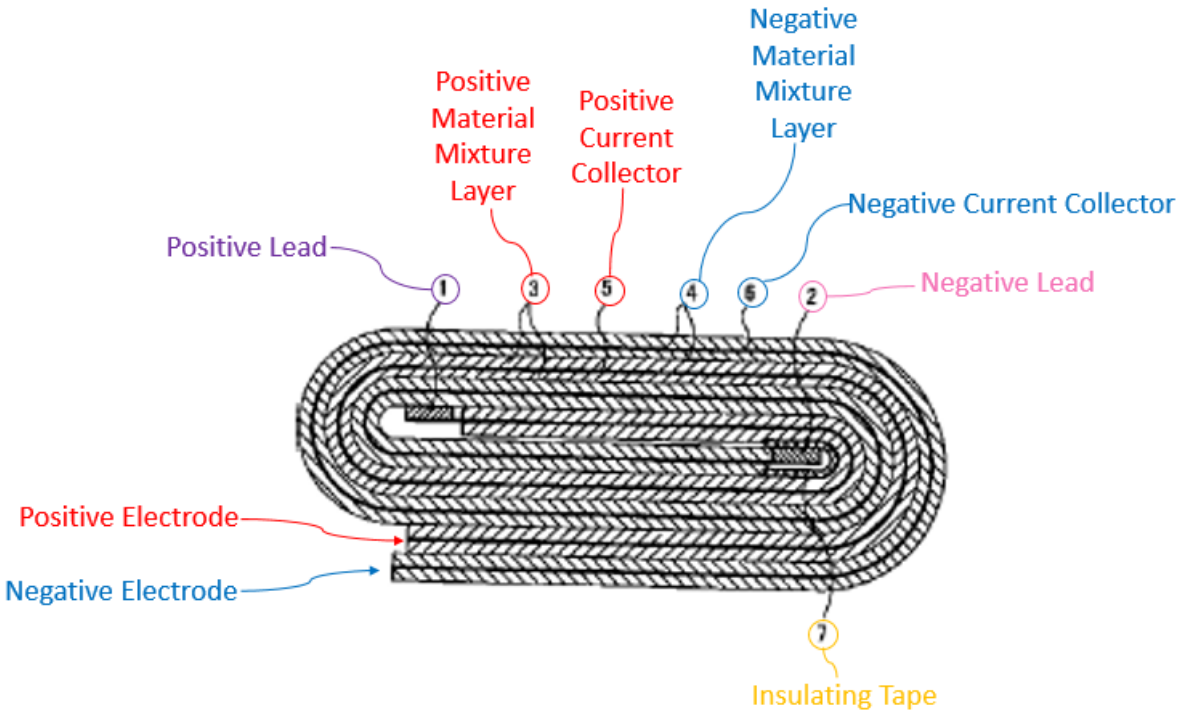
411. In view of Takemura's and Oh-539's disclosures, it would have been obvious to a POSA to move Takemura's positive lead 1 into a recess formed in the positive electrode active material layer 3 and centered at 40% to 60% of the total length of the positive current collector 5. This move would have reduced the reduce the length of current travel within the battery, compared to the location of lead 1 at the end of Takemura's positive current collector. EX1007, ¶[0009]. As explained by Oh-539 this would have provided at least the following benefits to Takemura's battery: improved high power characteristics, improved high-rate discharging characteristics, and improved reliability. EX1007, ¶¶ [0007], [0009]-[0010, and 100-105.

412. Accordingly, a POSA would have understood that the combined disclosures of Takemura and Oh-539 render Element [9.B] obvious.

**16. [9.C] "a negative electrode, comprising a negative current collector and a negative electrode active material layer being formed on the negative current collector"**

413. For the same reasons discussed above with respect to Element [1.C], Takemura discloses the recited "negative electrode" in the form of a negative electrode plate shown below in Figure 9, the recited "negative current collector" in the form of a negative electrode current collector 6, and the recited "negative

electrode active material layer" in the form of a negative electrode material layer 4. EX1006, ¶[0003].




EX1006, FIG. 9 (annotated).

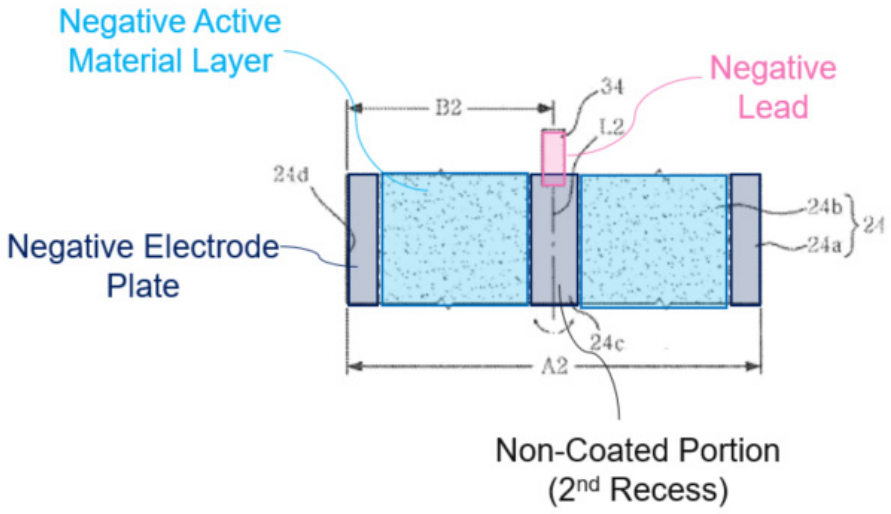
**17. [9.D] "the negative electrode active material layer being provided with a second recess accommodating a negative lead being coupled with the negative current collector;"**

**a. Takemura**

414. As discussed above with respect to Element [1.D], Takemura's battery shown in Figures 8 and 9 does not include a second recess in the negative active material layer 4 for accommodating the negative lead 2 coupled to the negative current collector 6.

**b. Oh-539**

415. For the same reasons discussed above with respect to Element [1.D], Oh-539 discloses placing a negative lead (anode tab 34) within a recess (non-coated portion 24c) formed in the negative active material (anode active material 24b) on a negative electrode 24 for a lithium-ion battery. EX1007, ¶¶[0056]-[0059] and FIG. 3. Oh-539 discloses placing a negative lead (anode tab 34) within the second recess (non-coated portion 24c) coupled to a negative current collector. EX1007, ¶¶[0061]-[0062].




EX1007, FIG. 3 (annotated).

**c. Combination of Takemura and Oh-539**

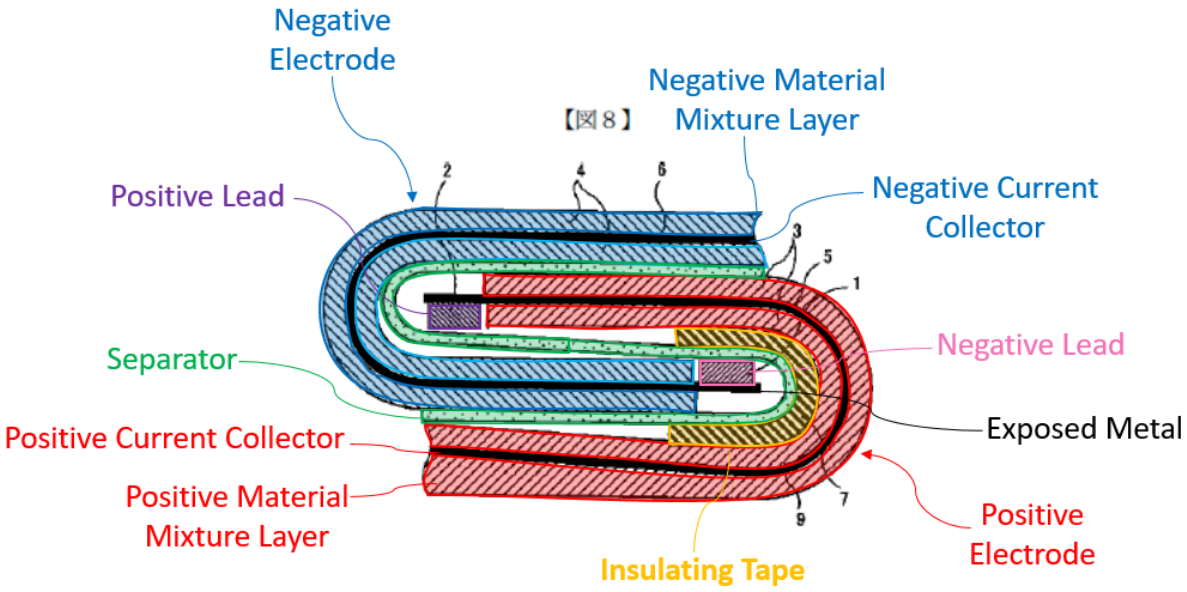
416. In view of Takemura's and Oh-539's disclosures, it would have been obvious to a POSA to move Takemura's negative lead 2 into a recess formed in the negative electrode active material layer 5 and centered at 40% to 60% of the total length of the negative current collector 6. This move would have reduced the

reduce the length of current travel within the battery, compared to the location of lead 2 at the end of Takemura's negative current collector. EX1007, ¶[0009]. As explained by Oh-539 this would have provided at least the following benefits to Takemura's battery: improved high power characteristics improved high-rate discharging characteristics, and improved reliability. EX1007, ¶¶ [0007], [0009]-[0010], and [0100]-[0105].

417. Accordingly, a POSA would have understood that the combined disclosures of Takemura and Oh-539 render Element [9.D] obvious.

**18. [9.E] "a separator disposed between the positive electrode and the negative electrode"**

418. For the same reasons discussed above with respect to Element [1.E], Takemura discloses the recited "separator" as annotated in green below in Figure 8. EX1006, ¶[0003].




EX1006, FIG. 8 (annotated).

**19. [9.F] "an electrolyte,"**

419. For the same reasons discussed above with respect to Element [1.F], Takemura discloses the recited "electrolyte" in the form of a "nonaqueous electrolyte solution." EX1006, ¶[0003].

**20. [9.G] "wherein, a first location of a top surface of the positive lead is provided with a first insulating glue layer,"**

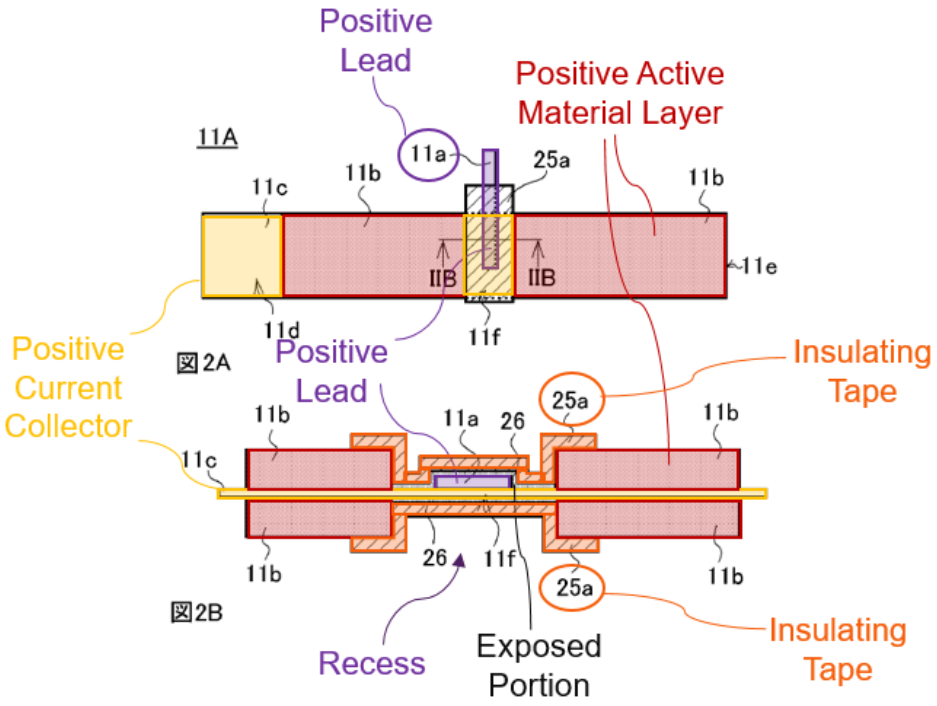
**a. Takemura and Oh-539**

420. As discussed above for element [9.B], Takemura combined with Oh-539 teaches a lithium-ion battery with a positive lead coupled to the positive current collector in a first recess formed in the positive active material layer. Takemura and Oh-539 do not specifically disclose providing a first insulating glue layer on a top surface of the positive lead. But placing an insulating tape in the form of an insulating tape on the top surface of the positive lead would have been

obvious in view of Kobayashi.

**b. Kobayashi**

421. For the same reasons discussed above with respect to Element [1.G], Kobayashi discloses tapes 25a on both the top and bottom surface of the exposed portion 11f of the positive electrode plate 11A. EX1008, ¶¶ [0034]-[0035]. A first piece of tape 25a is placed on the top surface covering the positive current collecting tab 11a and edges of the positive active material 11b adjacent the positive current collecting tab 11a. EX1008, ¶¶ [0034]-[0035]. Similarly, a second piece of tape 25a is placed on the bottom surface covering exposed metal foil opposite the positive current collecting tab 11a and edges of the positive active material 11b on the bottom surface. EX1008, ¶¶ [0034]-[0035].



EX1008, FIGs. 2A and 2B (annotated).

**c. Combination of Takemura, Oh-539, and Kobayashi**

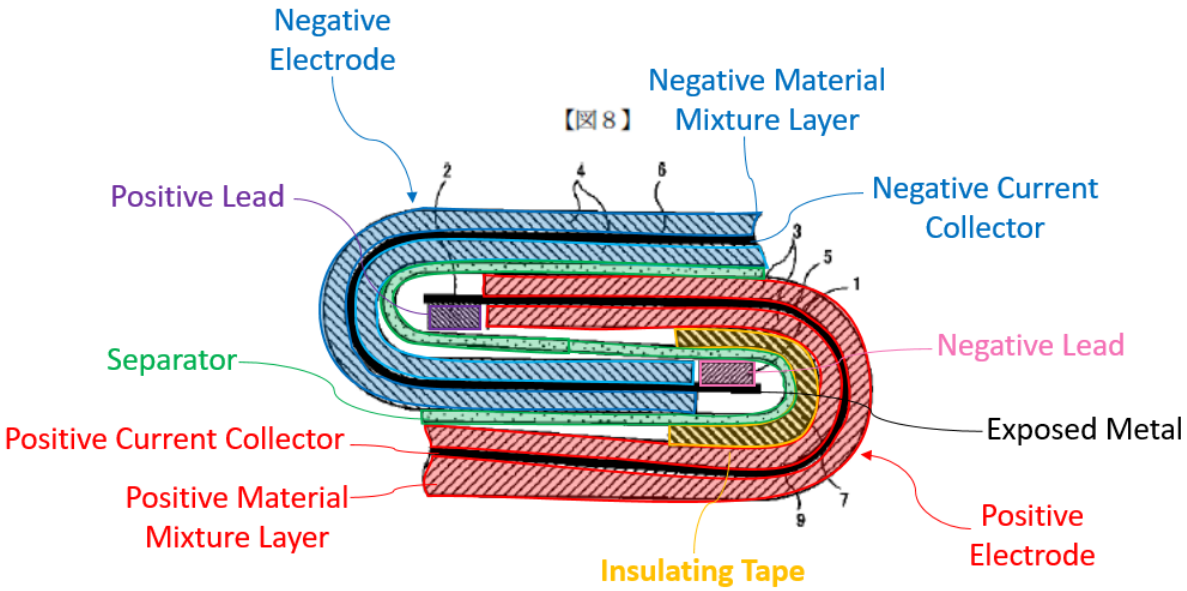
422. In view of Takemura's, Oh-539's, and Kobayashi's disclosures, it would have been obvious to a POSA to apply Kobayashi's first piece of tape 25a on the top surface of the positive lead positioned within the first recess in the Takemura-Oh-539 battery. Based on at least Kobayashi's disclosure, a POSA would have understood that the exposed metal and edges of positive active material around the positive current collector in the Takemura-Oh-539 battery are susceptible short-circuiting. EX1008, ¶[0014]. Applying Kobayashi's tape 25a to the top surface of the positive lead in the Takemura-Oh-539 battery would have amounted to nothing more than applying a tape to the Takemura-Oh-539 battery at a known location and for a known benefit.

423. Accordingly, the combined disclosures of Takemura, Oh-539, and Kobayashi render element [9.G] obvious.

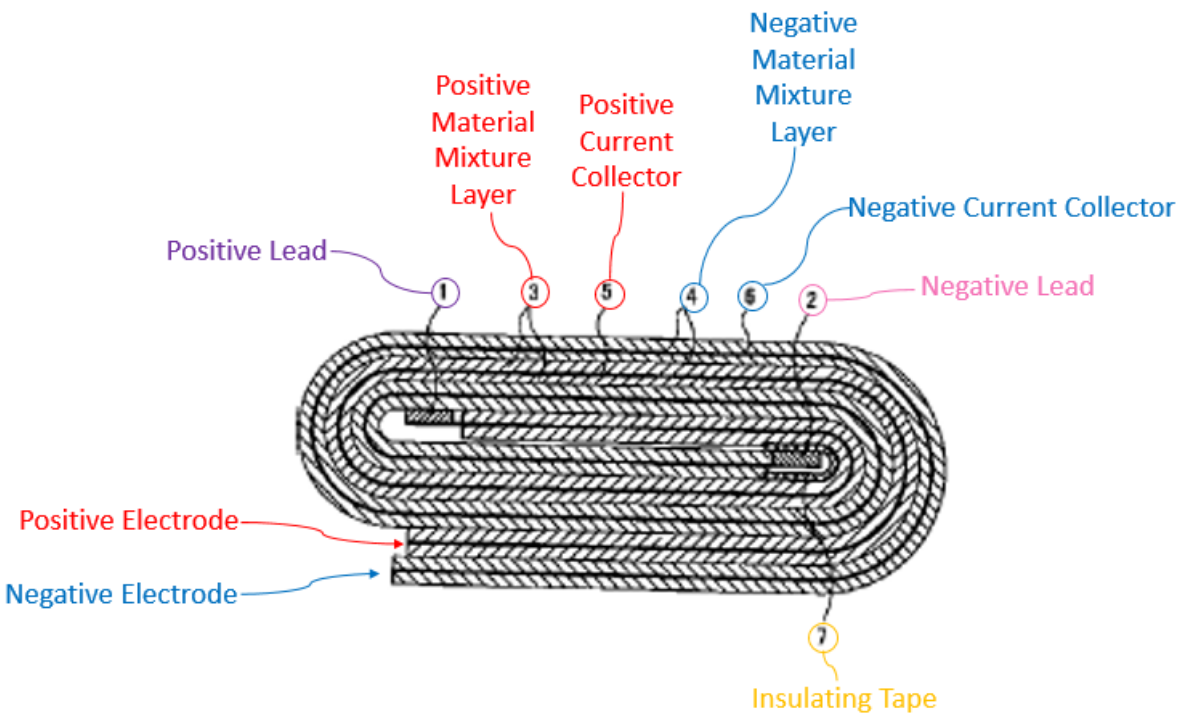
**21. [9.H] "a second location of a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer,"**

424. As discussed with respect to [9.D], Takemura-Oh-539 teaches forming a second recess in the negative active material layer to accommodate a lead connected to the negative current collector. As discussed in Section IX.D.9.b,

Takemura discloses attaching an insulating tape 7 to the positive active material layer 3 opposite both sides of the bare negative electrode current collector 6 where negative lead 1 is attached. EX1006, ¶[0008], FIGs. 8-9. The location of Takemura's insulating tape 7 in Figures 8 and 9 corresponds to the position of the claimed second insulating layer because Takemura's tape 7 is located on a surface of a positive active material layer and opposite a negative lead connection.

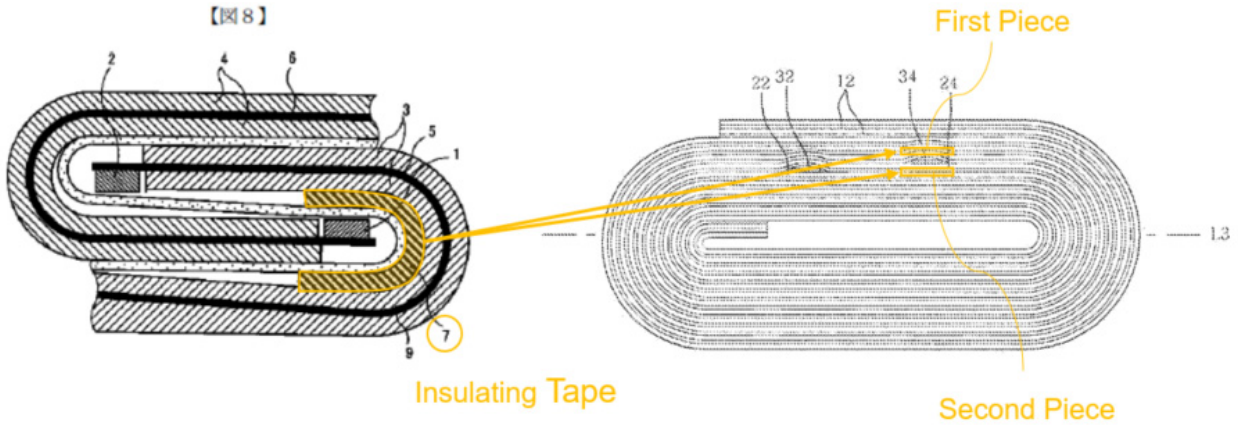



EX1006, FIG. 8 (annotated).




EX1006, FIG. 9 (annotated).

425. For the same reasons discussed with respect to element [1.H], in combining Oh-539's central placement of the negative lead connection with Takemura, a POSA would have rearranged Takemura's tape 7 on the surface of the positive active material layer 3 to be placed opposite both sides of the exposed anode foil where the negative lead is attached in order to shield it from lithium plating. The following annotated images of Takemura's Figure 8 and Oh-539's Figure 4 illustrate how a POSA would have applied Takemura's insulating tape 7 to the surface of the positive electrode active material layer 3 after moving the negative lead into a centrally located recess.




EX1006, FIG. 8 and EX1007, FIG. 4 (annotated).

426. As shown above, a POSA would have been motivated to divide Takemura's insulating tape 7, which is bent around top and bottom sides at an end of the electrode, into two pieces. The two pieces would be located at the second location as recited in element [9.H] of the '498 patent—namely on a surface of the positive electrode active material layer across the separator from the second recess, with the first piece above and the second piece below the second recess.

427. Accordingly, the combined disclosures of Takemura, Oh-539, and Kobayashi render element [9.H] obvious.

**22. [9.I.1] "a third location of a surface of the positive current collector opposite to the surface of the positive current collector where the positive lead is covered with another first insulating glue layer."**

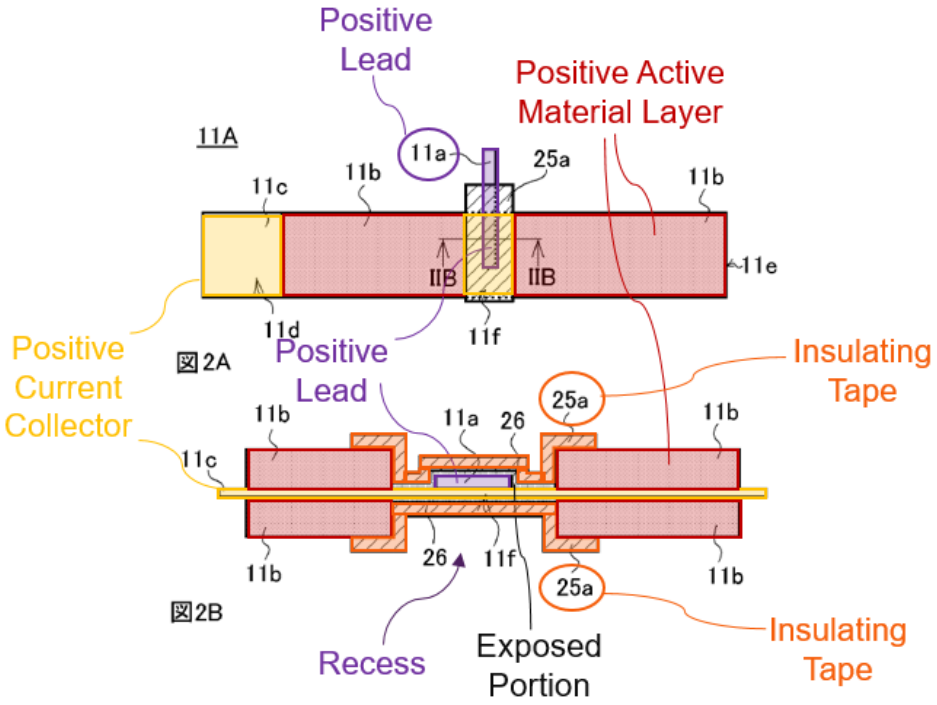
**a. Takemura-Oh-539**

428. As discussed for [9.B], Takemura-Oh-539 provides a first recess in the positive active material layer to accommodate a lead connected to the positive

current collector. Takemura-Oh-539 does not explicitly disclose applying another first insulating tape at a third location of a surface of the positive current collector that is opposite the surface of the current collector connected to the positive lead. But this was well known, as evidenced by Kobayashi.

**b. Kobayashi**

429. As I discussed in Section XV.E.20.b, Kobayashi discloses tapes 25a on both the top and bottom surface of the exposed portion 11f of the positive electrode plate 11A. EX1008, ¶¶[0034]-[0035], FIGs. 2A-2B.




EX1008, FIGs. 2A-2B (annotated).

**c. Combination of Takemura, Oh-539, and Kobayashi**

430. It would have been obvious to a POSA to apply another first

insulating tape on the bottom of Takemura-Oh-539's positive current collector, as taught by Kobayashi, to cover the exposed metal opposite the positive lead and the edges of the positive active material on the bottom side of the positive current collector in the Takemura-Oh-539 battery. A POSA would have been motivated to do so to protect the exposed metal surface from inadvertent contact with the anode, preventing short-circuiting. EX1008, ¶¶[0005], [0010], [0014]. This modification would have simply been combining a known element (another insulating tape) to a known device (Takemura's battery as modified by Oh-539 and Kobayashi), yielding the predictable result of preventing short-circuiting.

431. Accordingly, the combined disclosures of Takemura, Oh-539, and Kobayashi render element [9.1.I] obvious.

**23. [9.I.2] "the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of the second recess."**

432. For the same reasons discussed with respect to element [1.I], Takemura discloses an insulating tape 7 having a width (measured along the length of the negative electrode in the cross-section shown in Figures 8-9) greater than the exposed metal on the negative electrode current collector 6. In combining Oh-539's central placement of the negative lead connection with Takemura, a POSA would have kept the width of Takemura's insulating tape 7 greater than the width of the second recess formed in the negative active material 4 of Takemura's

negative electrode so that all exposed metal is covered by insulating tape 7.

433. Takemura does not explicitly disclose that the insulating tape 7 has a length larger than the length of the exposed metal on the negative electrode current collector 6. That said, a POSA would have understood, or at least found it obvious, to make the length of Takemura's tape 7 (measured along the width of the electrode) larger than the length of the current collector's exposed surface in the Takemura-Oh-539 battery to avoid exposing metal on the negative electrode to Lithium plating. Sizing the tape to have a length larger than the length of the exposed metal would have helped ensure that metal is not exposed as result of alignment variances. EX1022, 51 (explaining that "an underlapped condition [i.e., exposed metal on the negative electrode] may occur in some region of a cell, if dimensional and alignment tolerances are not adequately managed.").

434. Accordingly, the combined disclosures of Takemura, Oh-539, and Kobayashi render element [9.1.2] obvious.

**24. 10. "The lithium-ion battery of claim 9, wherein a distance between a center of the first recess and one end of the positive electrode active material layer is ¼-¾ of a length of the positive electrode active material layer, and a distance between a center of the second recess and one end of the negative electrode active material layer is ¼-¾ of a length of the negative electrode active material layer."**

435. For the same reasons discussed above with respect to claim 2, Oh-539 discloses that the first recess (non-coated portion 22c) is located at distance B1,

40% to 60% of the total length A1 of Oh-539's positive electrode 22, which falls with the claimed range of ¼ to ¾ of a length of the positive electrode. EX1007, ¶¶[0050]-[0051]. And Oh-539 discloses that the second recess (non-coated portion 24c) is located at distance B1 that is 40% to 60% of the total length A1 of Oh-539's negative electrode 24, which falls with the claimed range of ¼ to ¾ of a length of the negative electrode. EX1007, ¶¶[0061]-[0062].

436. In combining the teachings of Oh-539's recesses and lead. connections with Takemura, a POSA would have been motivated to locate the center of the first and second recesses at a distance from the end of the electrode by a distance corresponding to ¼ to ¾ of the electrode length, as taught by Oh-539, to reduce the internal current path, thereby improving the battery's high rate discharge characteristics.

**25. 11. "The lithium-ion battery of claim 9, wherein a distance between a center of the first recess and one end of the positive electrode active material layer is half of a length of the positive electrode active material layer, and a distance between a center of the second recess and one end of the negative electrode active material layer is half of a length of the negative electrode active material layer."**

437. For the same reasons discussed above with respect to claim 3, Oh-539 discloses that the first recess (non-coated portion 22c) is located at distance B1, 40% to 60% of the total length A1 of Oh-539's positive electrode 22, which includes the claimed value of 1/2. EX1007, ¶¶[0050]-[0051]. And Oh-539

discloses that the second recess (non-coated portion 24c) is located at distance B1 that is 40% to 60% of the total length A1 of Oh-539's negative electrode 24, which includes the claimed value of ½. EX1007, ¶¶[0061]-[0062]. Figures 2 and 3 are symmetric showing the recess centered at ½.

438. In combining Oh-539's recesses and lead connections with Takemura, a POSA would have been motivated to locate the center of the first and second recesses at a distance from the end of the electrode by a distance corresponding to half of the electrode length, as taught by Oh-539, to minimize the internal current path, thereby improving the battery's discharge rate.

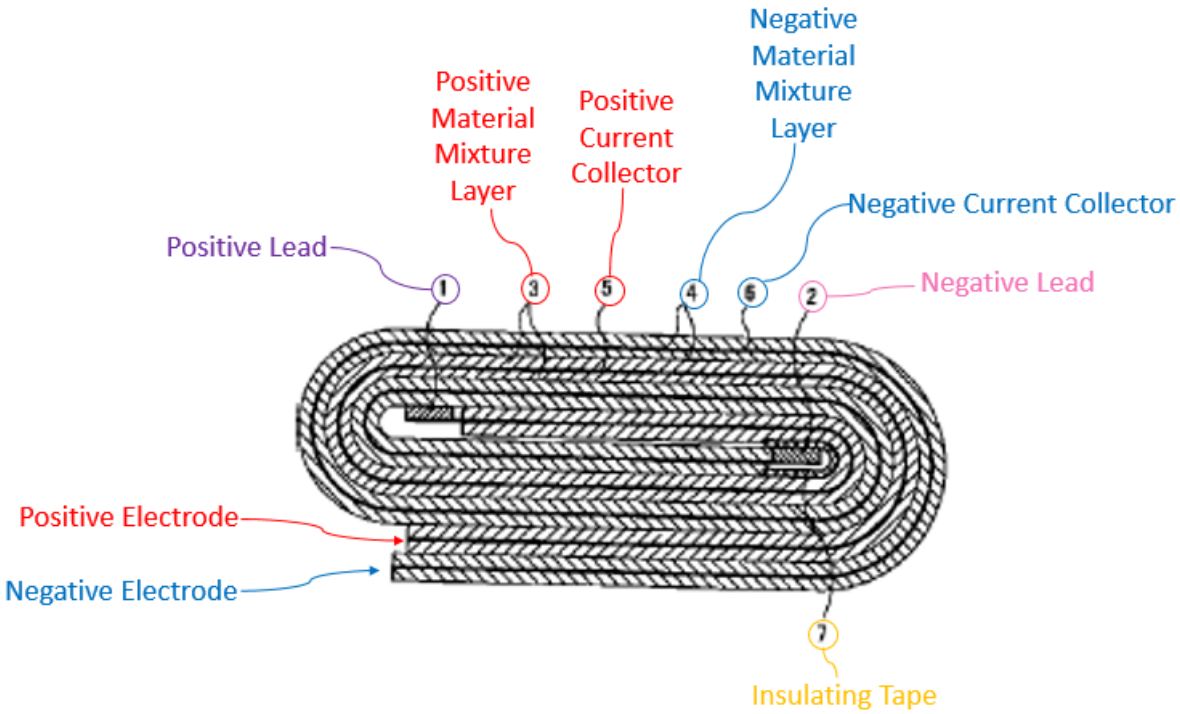
**26. [17.P]: "A lithium-ion battery, comprising:"**

439. For the same reasons discussed above with respect to Element [1.P], Takemura discloses a lithium-ion battery. EX1006, ¶¶[0003], [0035], FIGs. 8 and 9.

**27. [17.A] "a positive electrode, comprising a positive current collector and a positive electrode active material layer being formed on the positive current collector."**

440. For the same reasons discussed above with respect to Element [1.A], Takemura discloses the recited "positive electrode" in the form of positive electrode plate shown below in Figure 9, the recited "positive current collector" in the form of a positive electrode current collector 5, and the recited "positive electrode active material layer" in the form of positive electrode material layer 3.

EX1006, ¶¶[0003], [0025].




EX1006, FIG. 9 (annotated).

**28. [17.B] "the positive electrode active material layer being provided with a first recess accommodating a positive lead being coupled with the positive current collector"**

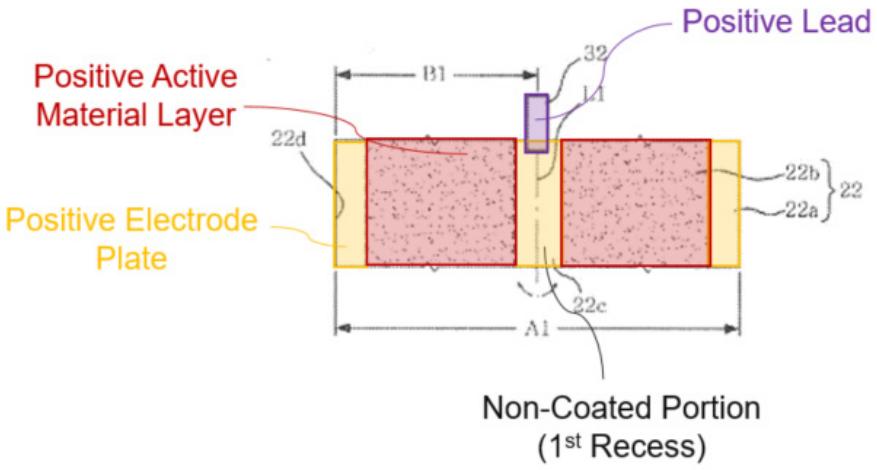
**a. Takemura**

441. As discussed above with respect to Element [1.B], Takemura's battery shown in Figures 8 and 9 does not include a first recess in the positive active material layer 3 for accommodating the positive lead 1 coupled to the positive current collector 5.

**b. Oh-539**

442. For the same reasons discussed above with respect to Element [1.B],

Oh-539 discloses placing a positive lead (cathode tab 32) within a first recess (non-coated portion 22c) formed in the positive active material (cathode active material 22b) on a positive electrode 22 for a lithium-ion battery. EX1007, ¶¶[0039]-[0046] and FIG. 2. Oh-539 discloses placing a positive lead (cathode tab 32) within the first recess (non-coated portion 22c) coupled to a positive current collector.




EX1007, FIG. 2 (annotated).

**c. Combination of Takemura and Oh-539**

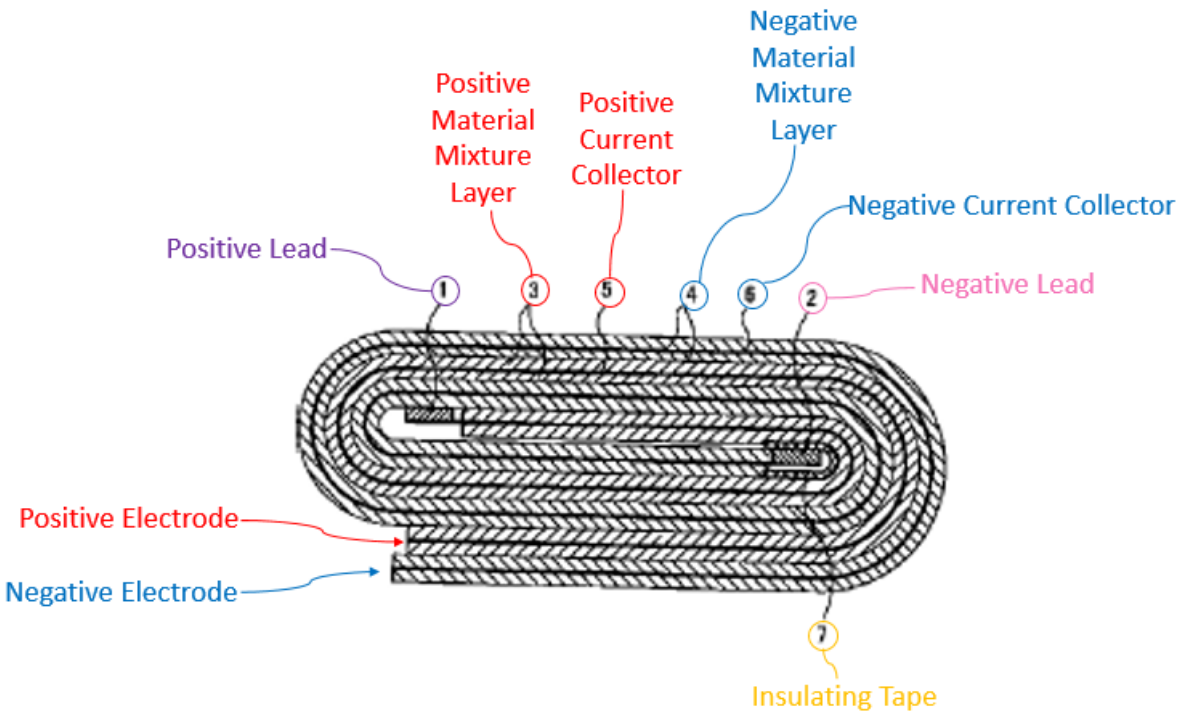
443. In view of Takemura's and Oh-539's disclosures, it would have been obvious to a POSA to move Takemura's positive lead 1 into a recess formed in the positive electrode active material layer 3 and centered at 40% to 60% of the total length of the positive current collector 5. This move would have reduced the reduce the length of current travel within the battery, compared to the location of lead 1 at the end of Takemura's positive current collector. EX1007, ¶[0009]. As explained by Oh-539 this would have provided at least the following benefits to

Takemura's battery: improved high power characteristics, improved high-rate discharging characteristics, and improved reliability. EX1007, ¶¶[0007], [0009]-[0010], and [0100]-[0105].

444. Accordingly, a POSA would have understood that the combined disclosures of Takemura and Oh-539 render Element [17.B] obvious.

### 29. [17.C] "a negative electrode, comprising a negative current collector and a negative electrode active material layer being formed on the negative current collector"

445. For the same reasons discussed above with respect to Element [1.C], Takemura discloses the recited "negative electrode" in the form of a negative electrode plate shown below in Figure 9, the recited "negative current collector" in the form of a negative electrode current collector 6, and the recited "negative electrode active material layer" in the form of a negative electrode material layer 4. EX1006, ¶[0003].




EX1006, FIG. 9 (annotated).

**30. [17.D] "the negative electrode active material layer being provided with a second recess accommodating a negative lead being coupled with the negative current collector;"**

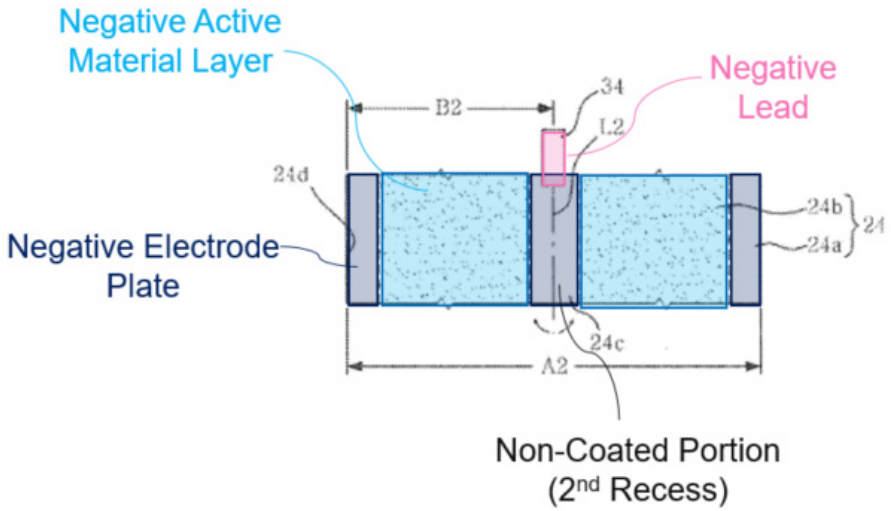
**a. Takemura**

446. As discussed above with respect to Element [1.D], Takemura's battery shown in Figures 8 and 9 does not include a second recess in the negative active material layer 4 for accommodating the negative lead 2 coupled to the negative current collector 6.

**b. Oh-539**

447. For the same reasons discussed above with respect to Element [1.D], Oh-539 discloses placing a negative lead (anode tab 34) within a recess (non-

coated portion 24c) formed in the negative active material (anode active material 24b) on a negative electrode 24 for a lithium-ion battery. EX1007, ¶¶[0056]-[0059] and FIG. 3. Oh-539 discloses placing a negative lead (anode tab 34) within the second recess (non-coated portion 24c) coupled to a negative current collector. EX1007, ¶¶[0061]-[0062].




EX1007, FIG. 3 (annotated).

**c. Combination of Takemura and Oh-539**

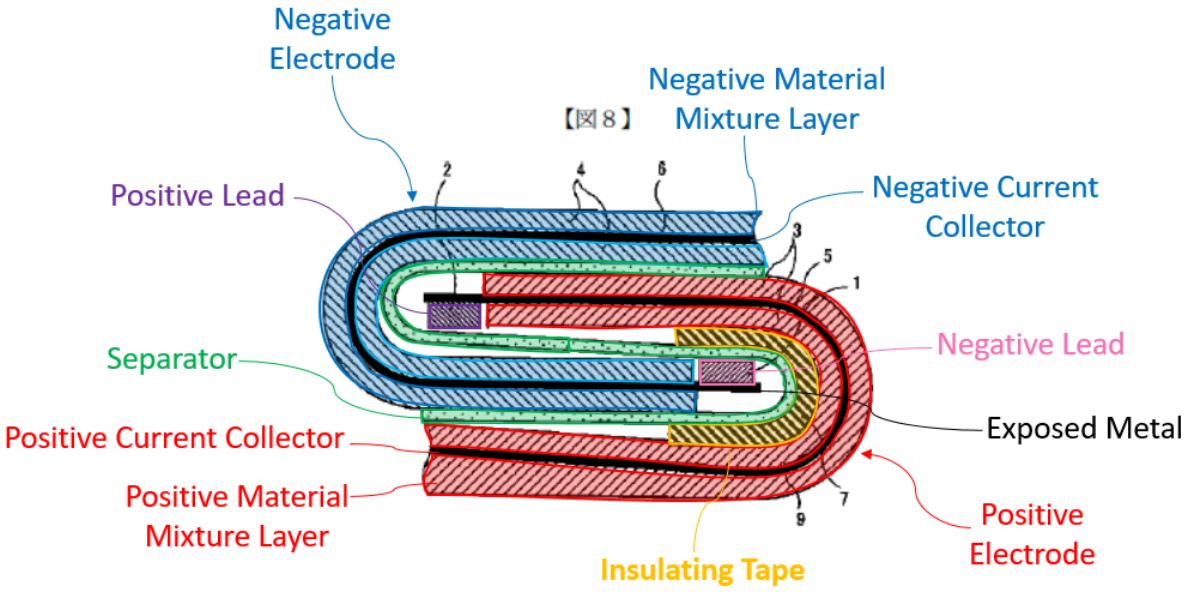
448. In view of Takemura's and Oh-539's disclosures, it would have been obvious to a POSA to move Takemura's negative lead 2 into a recess formed in the negative electrode active material layer 5 and centered at 40% to 60% of the total length of the negative current collector 6. This move would have reduced the reduce the length of current travel within the battery, compared to the location of lead 2 at the end of Takemura's negative current collector. EX1007, ¶[0009]. As explained by Oh-539 this would have provided at least the following benefits to

Takemura's battery: improved high power characteristics improved high-rate discharging characteristics, and improved reliability. EX1007, ¶¶ [0007], [0009]-[0010], and [0100]-[0105].

449. Accordingly, a POSA would have understood that the combined disclosures of Takemura and Oh-539 render Element [17.D] obvious

**31. [17.E] "a separator disposed between the positive electrode and the negative electrode"**

450. For the same reasons discussed above with respect to Element [1.E], Takemura discloses the recited "separator" as annotated in green below in Figure 8. EX1006, ¶[0003].




EX1006, FIG. 8 (annotated).

**32. [17.F] "an electrolyte,"**

451. For the same reasons discussed above with respect to Element [1.F],

Takemura discloses the recited "electrolyte" in the form of a "nonaqueous electrolyte solution." EX1006, ¶[0003].

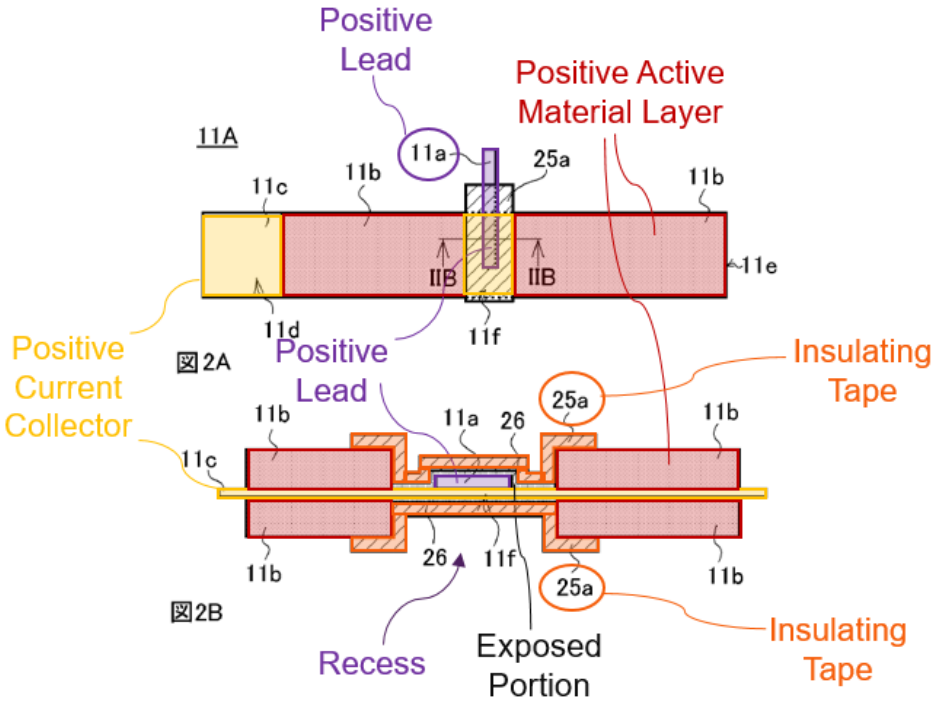
**33. [17.G] "wherein, a first location of a top surface of the positive lead is provided with a first insulating glue layer,"**

**a. Takemura and Oh-539**

452. As discussed above for element [17.B], Takemura combined with Oh-539 teaches a lithium-ion battery with a positive lead coupled to the positive current collector in a first recess formed in the positive active material layer. Takemura and Oh-539 do not specifically disclose providing a first insulating tape on a top surface of the positive lead. But placing an insulating tape on the top surface of the positive lead would have been obvious in view of Kobayashi.

**b. Kobayashi**

453. For the same reasons discussed above with respect to Element [1.G], Kobayashi discloses tapes 25a on both the top and bottom surface of the exposed portion 11f of the positive electrode plate 11A. EX1008, ¶¶[0034]-[0035]. A first piece of tape 25a is placed on the top surface covering the positive current collecting tab 11a and edges of the positive active material 11b adjacent the positive current collecting tab 11a. EX1008, ¶¶[0034]-[0035]. Similarly, a second piece of tape 25a is placed on the bottom surface covering exposed metal foil opposite the positive current collecting tab 11a and edges of the positive active material 11b on the bottom surface. EX1008, ¶¶[0034]-[0035].




EX1008, FIGs. 2A and 2B (annotated).

**c. Combination of Takemura, Oh-539, and Kobayashi**

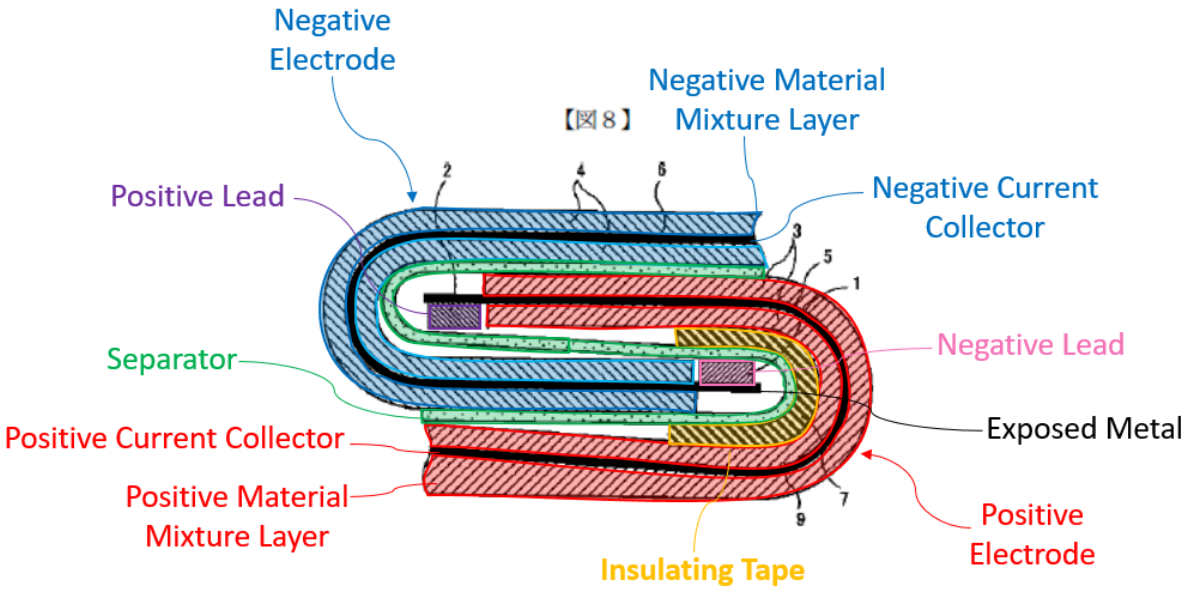
454. In view of Takemura's, Oh-539's, and Kobayashi's disclosures, it would have been obvious to a POSA to apply Kobayashi's first piece of tape 25a on the top surface of the positive lead positioned within the first recess in the Takemura-Oh-539 battery. Based on at least Kobayashi's disclosure, a POSA would have understood that the exposed metal and edges of positive active material on both the top side of the positive current collector in the Takemura-Oh-539 battery are susceptible short-circuiting. EX1008, ¶[0014]. Applying Kobayashi's tape 25a to the top surface of the positive lead in the Takemura-Oh-539 battery would have amounted to nothing more than applying a tape to the

Takemura-Oh-539 battery at a known location and for a known benefit.

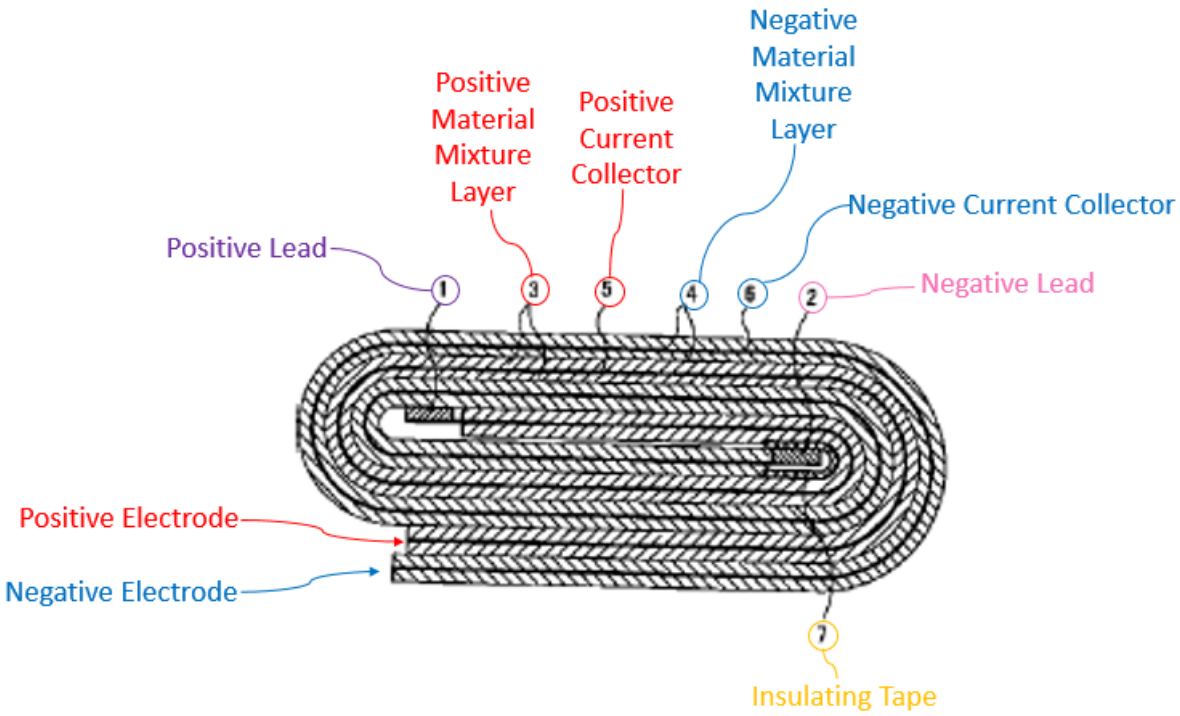
455. Accordingly, the combined disclosures of Takemura, Oh-539, and Kobayashi render element [17.G] obvious.

**34. [17.H] "a second location of a surface of the positive electrode active material layer opposite to the second recess across the separator in a thickness direction of the positive plate and the negative plate is pasted with a second insulating glue layer,"**

456. As discussed with respect to [17.D], Takemura-Oh-539 teaches forming a second recess in the negative active material layer to accommodate a lead connected to the negative current collector. As discussed in Section IX.D.9.b, Takemura discloses attaching an insulating tape 7 to positive active material layer 3 adjacent to separator 8 and across from a bare negative electrode current collector 6 where negative lead 1 is attached. EX1006, ¶[0008], FIGs. 8-9. The location of Takemura's insulating tape 7 in Figures 8 and 9 corresponds to the position of the claimed "second insulating tape" because Takemura's tape 7 is located on a surface of a positive active material layer and opposite a negative lead connection.



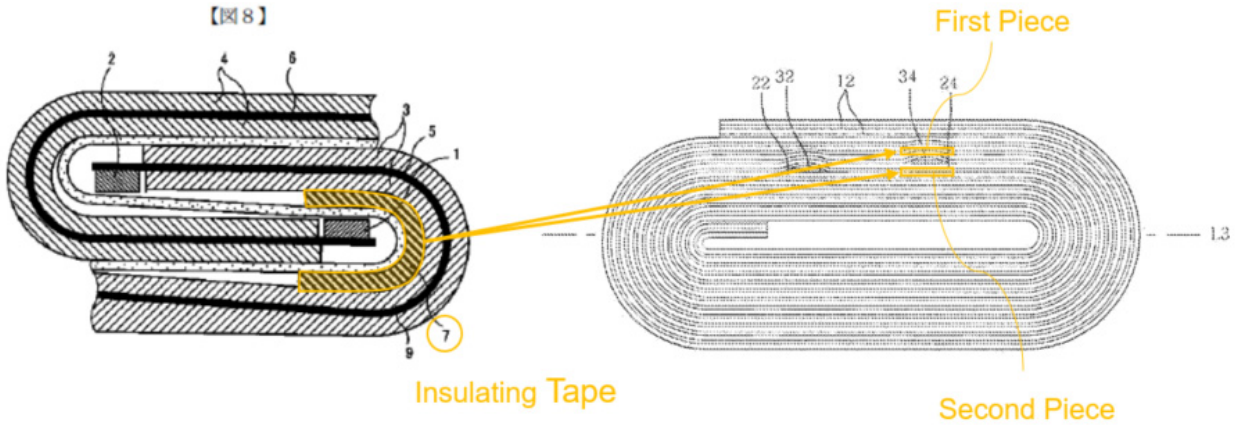

EX1006, FIG. 8 (annotated).




EX1006, FIG. 9 (annotated).

457. For the same reasons discussed with respect to element [1.H], in

combining Oh-539's central placement of the negative lead connection with Takemura, a POSA would have rearranged Takemura's tape 7 on the surface of positive active material layer 3 to remain opposite the negative lead connection because insulating tape 7. Doing so shields the exposed metal surfaces of the negative lead connection from lithium plating. The following annotated images of Takemura's Figure 8 and Oh-539's Figure 4 illustrate how a POSA would have applied Takemura's insulating tape 7 to the surface of the positive electrode active material layer 3 after moving the negative lead into a centrally located recess.




EX1006, FIG. 8 and EX1007, FIG. 4 (annotated).

458. As shown above, a POSA would have been motivated to divide Takemura's insulating tape 7, which is bent around top and bottom sides at an end of the electrode, into two pieces. The two pieces would be located at the second location as recited in element [17.H] of the '498 patent—namely on a surface of

the positive electrode active material layer across the separator from the second recess, with the first piece above and the second piece below the second recess.

459. Accordingly, the combined disclosures of Takemura, Oh-539, and Kobayashi render element [17.H] obvious.

### 35. [17.I] "the second insulating glue layer has a width larger than a width of the second recess, and the second insulating glue layer has a length larger than a length of the second recess."

460. For the same reasons discussed with respect to element [1.I], Takemura discloses an insulating tape 7 having a width (measured along the length of the negative electrode in the cross-section shown in Figures 8-9) greater than the exposed metal on the negative electrode current collector 6. In combining Oh-539's central placement of the negative lead connection with Takemura, a POSA would have kept the width of Takemura's insulating tape 7 greater than the width of the second recess formed in the negative active material 4 of Takemura's negative electrode so that all exposed metal is covered by insulating tape 7.

461. Takemura does not explicitly disclose that the insulating tape 7 has a length larger than the length of the exposed metal on the negative electrode current collector 6. That said, a POSA would have understood, or at least found it obvious, to make the length of Takemura's tape 7 (measured along the width of the electrode) larger than the length of the current collector's exposed surface in the Takemura-Oh-539 battery to avoid exposing metal on the negative electrode to

Lithium plating. Sizing the tape to have a length larger than the length of the exposed metal would have helped ensure that metal is not exposed as result of alignment variances. EX1022, 51 (explaining that "an underlapped condition [i.e., exposed metal on the negative electrode] may occur in some region of a cell, if dimensional and alignment tolerances are not adequately managed").

462. Accordingly, the combined disclosures of Takemura, Oh-539, and Kobayashi render element [17.I] obvious.

## XVI. GROUND 8: CLAIMS 20-22 WOULD HAVE BEEN OBVIOUS IN VIEW OF TAKEMURA IN COMBINATION WITH OH-539, KOBAYASHI, and OH-144.

### A. Oh-144

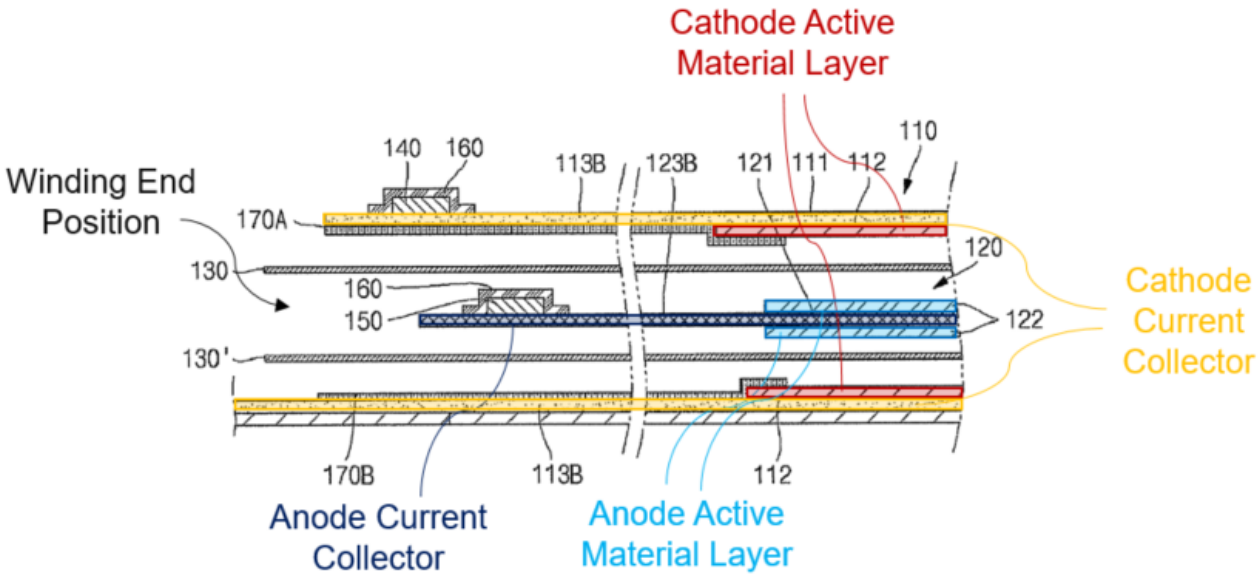
463. Oh-144 discloses a lithium-ion battery as I discussed above in Section XI.B.

### B. A POSA would have been motivated to combine Oh-144 with Takemura, Oh-539, and Kobayashi with a reasonable expectation of success.

464. Takemura, Oh-539, Kobayashi, and Oh-144 are analogous art as they all disclose coiled lithium-ion battery cells. EX1006, ¶[0001]; EX1007, ¶¶[0007], [0029]; EX1008, ¶¶[0014]-[0016]; EX1017, ¶¶[0025]-[0027]. They are from the same field and include the same building blocks—a positive electrode plate coated with positive active material, a positive lead attached to the positive electrode plate at an exposed portion, a negative electrode plate coated with negative active material, and a negative lead attached to the negative electrode plate at an exposed

portion. EX1006, ¶[0005]; EX1007, ¶¶[0039], [0043]; EX1008, ¶¶[0007], [0034]; EX1017, ¶¶[0025]-[0027].

465. Oh-144 discloses a lithium-ion battery with a positive electrode (cathode) plate 110, a negative electrode (anode) plate 120, and a separator 130. EX1017, ¶[0025], FIGs. 3-4. Oh-144's cathode plate 110 includes a cathode collector 111, a cathode active material layer 112, and uncoated cathode portions 113. EX1017, ¶[0026]. Oh-144's anode plate 120 includes an anode collector 121, an anode active material layer 122, and uncoated cathode portions 123. EX1017, ¶[0027]. The separator 130 is wound in a position between the cathode plate 110 and the anode plate 120. EX1017, ¶[0025]. "The uncoated portions at the winding end position are referred to as 'rear uncoated cathode or anode portions 113B or 123B.'" EX1017, ¶[0032].




EX1017, FIG. 4 (annotated).

466. Oh-144 also discloses disposing two tapes 170A, 170B on the cathode plate 110 at the winding end portion of the anode plate 120 to prevent short circuiting within a battery coil, for example a pouch-type battery coil, a rectangular battery or a cylindrical battery. EX1017, ¶¶[0037]-[0039], [0041]-[0042], [0045].

467. A first tape 170A covers the bottom (inner side) surface of the uncoated cathode portion 113B above exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0038]. Oh-144's tape 170A of the cathode plate 110 "corresponds to the outer surface of the rear anode uncoated portion 123B of the anode plate 120" to prevent "a short circuit that could be caused by contact between the rear cathode uncoated portion 113B of the cathode plate 110 and rear anode uncoated portion 123B of the anode." EX1017, ¶[0038].

468. A second tape 170B covers a top (outer side) surface of the uncoated cathode portion 113B below exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0039]. Oh-144's second tape 170B "corresponds to the inner surface of the rear anode uncoated portion 123B of the anode plate 120" to prevent "a short circuit that could be caused by contact between the rear anode uncoated portion 123B of the anode plate 120 and rear cathode uncoated portion 113B of the cathode plate 110." EX1017, ¶[0039]. The outer side surface of the uncoated cathode portion 113B remains uncoated for approximately one complete revolution in the winding because this outer side surface would directly face the

battery case around the perimeter of the coil. EX1017, ¶[0036], FIG. 3. Therefore, the second tape 170B is positioned at approximately one complete revolution in the winding such that its location corresponds to the inner surface of the rear anode uncoated portion 123B as shown in FIGS. 3 and 4.

469. A POSA would have been motivated to modify the Takemura-Oh-539-Koyabashi combination in view of Oh-144 to add insulating tapes on opposite inner and outer surfaces of the positive plate at non-coated surfaces 22a in Oh-539 such that (i) a winding end of the negative plate is located between the two insulating tapes and (ii) the two insulating tapes extend over the winding end of the negative plate as disclosed by Oh-144. Adding these two tapes would have helped prevent short circuits caused by contact between uncoated cathode and anode portions located at the winding end of the cathode and anode. Oh-144 specifically teaches that positioning two tapes in this manner prevents short circuits in pouch-type wound battery coils, like those in Takemura-Oh-539-Kobayashi. EX1007, ¶[0092]; EX1017, ¶¶[0041]-[0042]. Improving short-circuit resistance within lithium-ion batteries by placing insulating tapes adjacent exposed metal on the anode was also known well before January 2014. For example, Mizutani (EX1011) placed insulating tape 7/11 one a positive electrode at locations facing exposed metal portions on the negative electrode to avoid metal-to-metal shorts that can cause overheating. EX1011, ¶¶[0009], [0014].

470. A POSA therefore would have been motivated to modify the Takemura-Oh-539-Kobayashi battery in view of Oh-144 to apply two insulating tapes on opposite inner and outer surfaces of Takemura's positive plate such that a winding end of Takemura's negative plate is located between the two tapes and the two tapes extend over the winding end to prevent short circuits between exposed metal on Takemura's positive and negative plates. Adding insulating tapes as disclosed by Oh-144 would simply have been applying a known technique—placing tapes around the winding end of the negative electrode—to improve a known device—Takemura-Oh-539-Kobayashi's battery. Doing so would have helped prevent short circuits in the Takemura-Oh-539-Kobayashi battery.

471. A POSA would also have had a reasonable expectation of success combining Takemura, Oh-539, Kobayashi, and Oh-144 because applying insulating tapes in coiled lithium ion battery cells was a common solution for preventing short-circuiting well before 2014. EX1006, ¶¶3, 8, 22; EX1009, ¶8; EX1010, ¶29; EX1011, ¶18. Specifically, insulating tapes were known to help prevent short-circuiting between opposing exposed metal portions on positive and negative electrodes within coiled lithium-ion batteries. EX1017, ¶¶[0038]-[0039]; EX1011, ¶¶[0009], [0014]. A POSA would have expected Oh-144's tapes 170A, 170B incorporated into the Takemura-Oh-539-Koyabashi battery to perform their intended function of insulating exposed metal to prevent short-circuiting at the

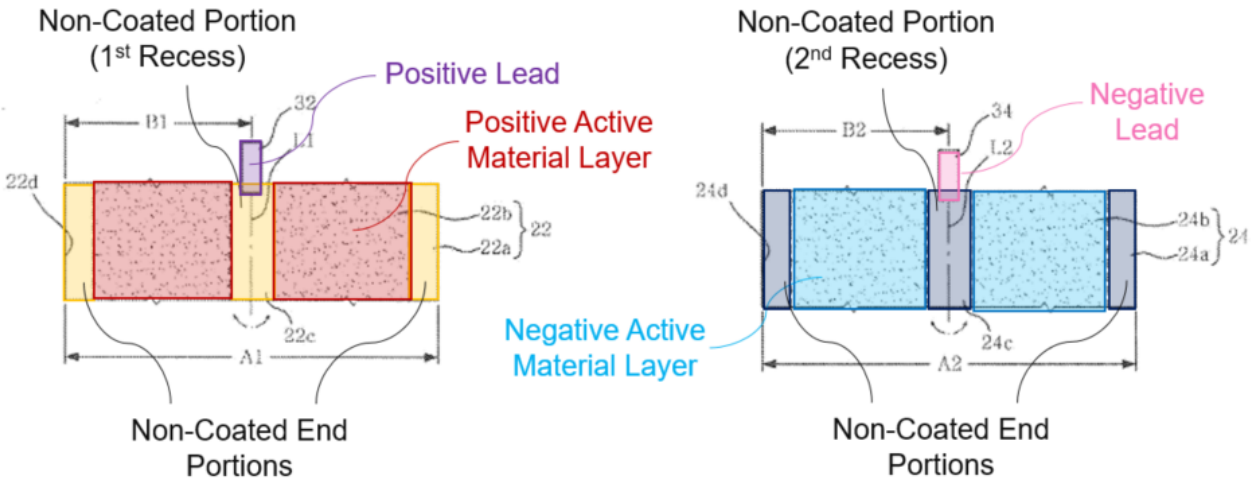
winding end of the negative electrode. Combining Oh-144's tapes 170A, 170B with the Takemura-Oh-539-Koyabashi battery would have simply been applying a known technique—placing Oh-144's tapes on opposite surfaces of the electrode's end—to a known device—Takemura-Oh-539-Koyabashi battery—yielding the predictable result of preventing short-circuiting.

### C. The combination of Takemura, Oh-539, Kobayashi, and Oh-144 renders obvious claims 20-22.

472. Claims 20-22 all recite "two insulating layers are disposed on two opposite surfaces of the positive plate, and a winding end of the negative plate is located between the two insulating layers; and the two insulating layers extend over the winding end of the negative plate along the winding direction."

#### 1. Combination of Takemura, Oh-539, and Kobayashi

473. As discussed in Section XV.D.1, it would have been obvious to modify Takemura in view of Oh-539 to move Takemura's positive and negative leads into recesses formed in the positive electrode active material layer and negative active material layer. This modification would result in Takemura's electrodes having the same layout as Oh-539's electrodes, with leads attached to centrally located non-coated portions 22c (recesses) and non-coated end portions 22a.



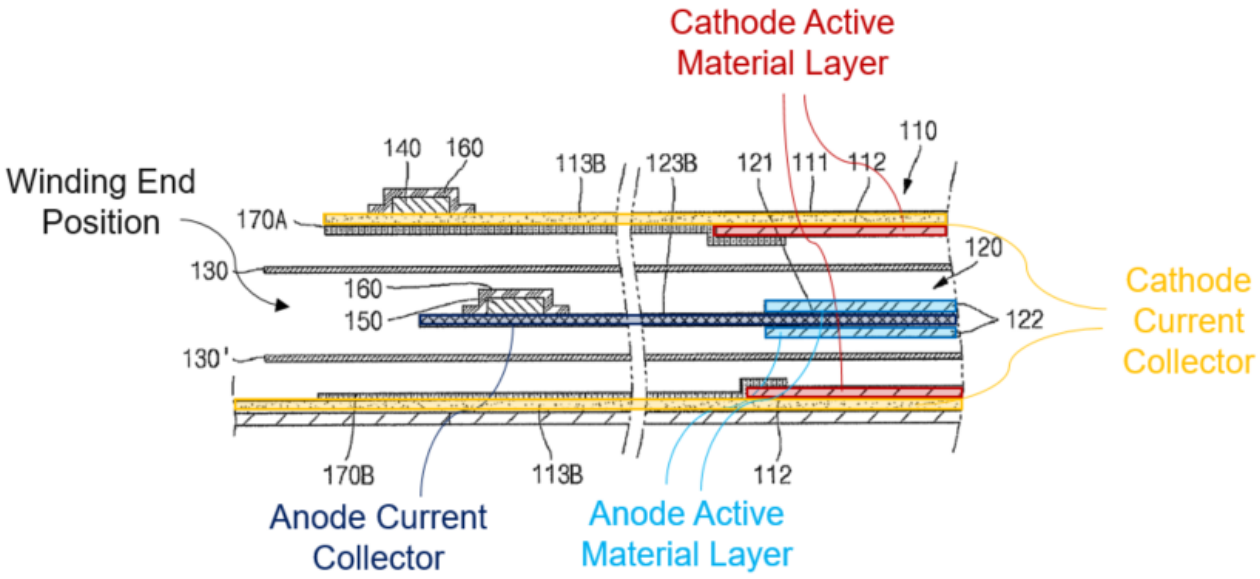

EX1007, FIGs. 2-3 (annotated).

474. The combination of Takemura, Oh-539, and Kobayashi does not explicitly disclose two insulating tapes disposed on opposite surfaces of the positive plate such that a winding end of the negative plate is located between the two tapes and the two tapes extend over the winding end. But including these two tapes in the Takemura-Oh-539-Kobayashi battery would have been obvious in view of Oh-144.

**2. Oh-144**

475. Oh-144 discloses two tapes 170A, 170B disposed on the cathode plate 110 at the winding end portion of the anode plate 120. A first tape 170A covers the bottom (inner side) surface of the uncoated cathode portion 113B above exposed metal 123B on the anode collector 121 at the winding end. EX1017, ¶[0038]. A second tape 170B covers a top (outer side) surface of the uncoated cathode portion 113B below exposed metal 123B on the anode collector 121 at the winding end.

EX1017, ¶[0039]. Both of these tapes 170A, 170B are positioned to prevent short circuits that could be caused by contact between exposed metal in uncoated cathode and anode portions. EX1017, ¶¶[0038]-[0039].




EX1017, FIG. 4 (annotated).

### 3. Combination of Takemura, Oh-539, Kobayashi, and Oh-144

476. It would have been obvious to position Oh-144's tapes 170A, 170B on inner and outer surfaces of non-coated end portions 22a of the positive electrode in the Takemura-Oh-539-Kobayashi battery, as shown in above in annoated FIG. 4 from Oh-144.

477. By positioning Oh-144's tapes 170A, 170B in this manner and winding the battery coil as illustrated by Oh-144, the two tapes 170A, 170B would be disposed on opposite inner and outer surfaces of the positive plate such that a winding end of the negative plate is located between the two tapes and the two

tapes extend over the winding end, as shown above. Applying the tapes 170A, 170B to on opposite surfaces of the positive plate in this manner in the Takemura-Oh-539-Kobayashi battery would have simply been applying additional tapes at known locations for a known benefit of improving short-circuit resistance.

## XVII. OBJECTIVE INDICIA DO NOT SUPPORT PATENTABILITY.

478. I understand that the obviousness analysis includes considering evidence of secondary indicia of nonobviousness (if available). I understand that any secondary indicia of nonobviousness must have a nexus, or a close connection, to the novel aspects of the claimed invention. I understand that secondary indicia of nonobviousness include the following: commercial success, long-felt but unmet need, failure of others, copying, praise in the industry, and unexpectedly superior results as compared with the closest prior art.

479. Considering the information I have reviewed, my general knowledge of the field of lithium-ion battery manufacturing and/or design, and publications within that and related fields, I am not aware of any objective evidence that might support the patentability of the claims of the ’498 patent. Should any alleged secondary indicia of nonobviousness be presented, I reserve the right to provide an opinion thereon.

## XVIII. CONCLUSION

I understand that this Declaration is to be filed as evidence in a contested IPR proceeding before the Patent Trial and Appeal Board. I acknowledge that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

I hereby declare that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I could testify to the matters in this declaration competently if called upon to do so. I further declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of the Title 18 of the United States Code.

Executed on this 14th day of January, 2025, in Sidney, B.C. Canada

Ulrich von Sacken, Ph.D.