

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHUHAI COSMX BATTERY CO., LTD.,
Petitioner

v.

NINGDE AMPEREX TECHNOLOGY LIMITED,
Patent Owner

Case IPR2026-00409
U.S. Patent No. 12,278,330

**DECLARATION OF ULRICH VON SACKEN, PH.D. IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO.
12,278,330**

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TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	MY PROFESSIONAL EXPERIENCE AND QUALIFICATIONS.....	1
III.	LEGAL PRINCIPLES.....	8
	A. Obviousness.....	9
	B. Claim Construction.....	12
IV.	MATERIALS CONSIDERED AND BASIS OF OPINIONS.....	12
V.	DESCRIPTION OF THE RELEVANT FIELD AND A PERSON OF ORDINARY SKILL IN THE RELEVANT FIELD (ART)	16
VI.	THE DATE OF THE PATENT.....	17
VII.	BACKGROUND OF CONVENTIONAL LITHIUM-ION BATTERY TECHNOLOGY	18
	A. Fundamental structures of conventional lithium-ion batteries.....	18
	B. Larger lead tabs improve conventional lithium-ion battery performance.....	23
	C. Insulating tape(s) prevent lithium-plating and/or short-circuiting within conventional lithium-ion batteries.	25
VIII.	THE '330 PATENT	47
	A. Summary of the '330 patent.....	47
	B. Prosecution History of the '330 patent.....	54
	C. '330 patent Claims.....	56
IX.	GROUND 1: CLAIMS 1-3, 6, 8, 10-13, 16, AND 18 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO, TAKEMURA, AND KODAMA.	57
	A. U.S. Patent Pub. No. 2011/0111276 to Sato <i>et al.</i> (Sato)	57
	B. Japanese Patent Pub. No. 2000-67907 to Takemura <i>et al.</i> (Takemura)	63
	C. Japanese Patent Pub. No. 2004-303950 to Kodama <i>et al.</i> (Kodama).....	68
	D. A POSA would have been motivated to combine Takemura with Sato and Kodama with a reasonable expectation of	

success.	70
E. A POSA would have been motivated to combine Kodama with Sato and Takemura with a reasonable expectation of success.....	74
F. Independent Claims 1 and 11	81
1. [1.P]/[11.P] A lithium-ion battery, comprising:	81
2. [1.A]/[11.A] a positive electrode comprising a positive current collector and a positive electrode active material layer [containing lithium cobalt oxide, wherein the positive electrode active material layer is / being] formed on the positive current collector, and.....	82
3. [1.B]/[11.B] [wherein] the positive electrode active material layer is provided with a first recess accommodating a positive lead being coupled with the positive current collector;	84
4. [1.C]/[11.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 / being] formed on the negative current collector,.....	86
5. [1.D][11.D] [wherein] the negative electrode active material layer [is / being] provided with a second recess accommodating a negative lead being coupled with the negative current collector; and.....	88
6. [1.E][11.E] the negative lead is disposed on a surface of the negative current collector facing away from the center of the battery; and.....	90
a. Sato	90
b. Takemura	91
c. Sato-Takemura Combination.....	92
7. [1.F][11.F] a portion of the negative current collector where the negative lead is disposed extends towards the center of the battery;	93
a. Sato	93
b. Kodama.....	93

c.	Sato-Kodama-Takemura Combination.....	95
8.	[1.G][11.G] a separator disposed between the positive electrode and the negative electrode; and	96
9.	[1.H][11.H] an electrolyte.....	97
G.	Claims 2/12 “wherein a distance between a center of the first recess and one end of the positive electrode active material layer is $\frac{1}{4}$ - $\frac{3}{4}$ 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 $\frac{1}{4}$ - $\frac{3}{4}$ of a length of the negative electrode active material layer.”.....	98
H.	Claims 3/13.....	102
1.	[3.A]/[13.A] wherein, the positive lead is disposed on a surface of the positive current collector facing a center of the battery.....	102
a.	Sato	102
b.	Takemura	102
c.	Sato-Kodama-Takemura Combination.....	103
2.	[3.B]/[13.B] a portion of the positive current collector where the positive lead is disposed extends away from the center of the battery.....	104
a.	Sato	104
b.	Kodama.....	104
c.	Sato-Kodama-Takemura Combination.....	106
I.	Claims 6/16 “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.”	107
J.	Claims 8/18 “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.”	111
K.	Claim 10	112
1.	[10.A] wherein a top surface of the positive lead is provided with a first insulating glue layer	112

2.	[10.B] a surface of the positive electrode active material layer corresponding to the second recess is pasted with a second insulating glue layer,.....	115
a.	Sato	115
b.	Takemura	118
c.	Sato-Kodama-Takemura Combination.....	120
3.	[10.C] 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.....	126
a.	Sato	127
b.	Takemura	127
c.	Sato-Kodama-Takemura Combination.....	130
X.	GROUND 2: CLAIMS 4, 5, 7, 14, 15, AND 17 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO, TAKEMURA, KODAMA, AND NAKAMURA.	132
A.	U.S. Patent Pub. No. 2011/0111276 to Sato <i>et al.</i> (Sato)	132
B.	Japanese Patent Pub. No. 2000-067907 to Takemura <i>et al.</i> (Takemura)	132
C.	Japanese Patent Pub. No. 2004-303950 to Kodama <i>et al.</i> (Kodama).....	132
D.	Japanese Patent Pub. No. 2003-068271 to Nakamura <i>et al.</i> (Nakamura).....	132
E.	A POSA would have been motivated to combine Nakamura with Sato, Kodama, and Takemura with a reasonable expectation of success.	135
F.	Claims 4/14 “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-[1.00/100] 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.”	140
1.	Sato.....	140
2.	Nakamura	142

3.	Sato-Kodama-Takemura-Nakamura Combination.....	147
G.	Claims 5/15 “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.”.....	148
1.	Sato.....	148
2.	Nakamura.....	149
3.	Sato-Kodama-Takemura-Nakamura Combination.....	152
H.	Claims 7/17 “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 a 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.”.....	154
1.	Sato.....	154
2.	Nakamura.....	155
3.	Sato-Kodama-Takemura-Nakamura Combination.....	157
XI.	GROUND 3: CLAIMS 9, 19, AND 20 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO, TAKEMURA, KODAMA, AND KOBAYASHI.....	158
A.	U.S. Patent Pub. No. 2011/0111276 to Sato <i>et al.</i> (Sato)	158
B.	Japanese Patent Pub. No. 2000-067907 to Takemura <i>et al.</i> (Takemura)	158
C.	Japanese Patent Pub. No. 2004-303950 to Kodama <i>et al.</i> (Kodama).....	159
D.	Japanese Patent Pub. No. 2010-055906 to Kobayashi <i>et al.</i> (Kobayashi)	159
E.	A POSA would have been motivated to combine Kobayashi with Sato, Kodama, and Takemura with a reasonable expectation of success.	161
F.	Claim 9 “wherein a surface of the positive current collector corresponding to the positive lead is covered with a third insulating glue layer.”	167
1.	Sato.....	167

2.	Kobayashi.....	168
3.	Sato-Kodama-Takemura-Kobayashi Combination	168
G.	Claim 19	169
1.	[19.A] “wherein a first location of a top surface of the positive lead is provided with a first insulating glue layer”	169
2.	[19.B] “a second location of a surface of the positive electrode active material layer corresponding to the second recess is pasted with a second insulating glue layer”	170
3.	[19.C] “a third location of a surface of the positive current collector corresponding to the positive lead is covered with a third insulating glue layer.”	170
H.	Claim 20 “wherein 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.”	171
XII.	OBJECTIVE INDICIA DO NOT SUPPORT PATENTABILITY.	172
XIII.	CONCLUSION.....	173

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. 12,278,330 (“the ’330 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 ’330 patent.

2. I have been asked to provide my independent analysis of the ’330 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 Ph.D, 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-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/for] 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).
- U. von Sacken, Q. Zhong, Yuan Gao and J.R. Dahn, “Methods for Preparing $\text{Li}_{1+x}\text{Mn}_{2-x}\text{O}_4$ with Improved High Temperature Electrochemical Performance,” CA 2164385 (granted June 13, 2000); U.S. Patent No. 5,700,597 (granted Dec. 23, 1997).
- Qiming Zhong and Ulrich von Sacken, “Low viscosity electrolyte comprising P_2O_5 for use in non-aqueous rechargeable lithium batteries,” U.S. Patent No. 5,650,245 (granted July 22, 1997).
- J.R. Dahn, U. von Sacken and R. Fong, “Lithiated Nickel Dioxide and Secondary Cells Prepared Therefrom,” U.S. Patent No. 5,264,201 (granted Nov. 23, 1993); CA2038631A (filed March 19, 1991); (Filed in Japan, May 20, 1991), Hei-3-145,396I; EP0468942 (granted Dec. 1, 1999); EP0702421 (granted Dec. 16, 1998).
- Ulrich von Sacken, “Hydrides of lithiated nickel dioxide and secondary cells prepared therefrom,” U.S. Patent No. 5,180,574 (granted Jan. 19, 1993).
- U. von Sacken, T. Van Buuren and J.R. Dahn, “Preparation of

VO₂(B) and a non-aqueous secondary cell using VO₂(B) Cathode,”

U.S. Patent No. 4,965,150, (granted Oct. 23 1990).

Publications:

- Qiming Zhong and U. von Sacken, “Crystal structures and electrochemical properties of LiAl_yNi_{1-y}O₂ solid solution” Journal of Power Sources, **54**, 221-223 (1995)
- U. von Sacken, E. Nodwell, A. Sundher and J.R. Dahn, Comparative Thermal Stability of Carbon Intercalation Anodes and Lithium Metal Anodes for Rechargeable Lithium Batteries, Journal of Power Sources, **54**, 240-245 (1995).
- Tao Zheng, Yinghu Liu, E.W. Fuller, Sheilla Tseng, U. von Sacken and J.R. Dahn,
- Lithium Insertion in High Capacity Carbonaceous Materials, J. Electrochem. Soc., **142**, 2581-2590 (1995).
- U. von Sacken, E. Nodwell, A. Sundher and J.R. Dahn, Comparative Thermal Stability of Carbon Intercalation Anodes and Lithium Metal Anodes for Rechargeable Lithium Batteries, Solid State Ionics, **69**, 284-290 (1994).
- J.R. Dahn, E.W. Fuller, M. Obrovac, U. von Sacken, Thermal Stability of Li_xCoO₂, Li_xNiO₂ and λ-MnO₂ and Consequences for

the Safety of Li-ion cells, Solid State Ionics, **69**, 265-270 (1994).

- J.R. Dahn, A.K. Sleight, Hang Shi, J.N. Reimers, B.M. Way, Q. Zhong, U. Von Sacken, Carbons and Graphites as Substitutes for the Lithium Anode, in Lithium Batteries; New Materials, New Perspectives, ed. by G. Pistoia, Elsevier - North Holland, Dec. pp. 1-47 (1993).
- J.N. Reimers, J.R. Dahn and U. Von Sacken, Effect of Impurities on the Electrochemical Properties of LiCoO₂, J. Electrochem. Soc., **140**, 2752-2754 (1993).
- J.N. Reimers, J.R. Dahn, J.E. Greedan, C.V. Stager, G. Liu, I. Davidson and U. von Sacken, Spin-Glass Behaviour in the Frustrated Antiferromagnet LiNiO₂. J. Solid State Chemistry, **102**, 542 (1993).
- J.R. Dahn, U. von Sacken, H. Al Janaby and M.W. Juzkow, Rechargeable LiNiO₂/Carbon Cells, J. Electrochem. Soc., **138**, 2207 (1991).
- I. Davidson, J.E. Greedan, U. von Sacken, C.A. Michael and J.R. Dahn, Structure of 1T Li₂NiO₂ from Powder Neutron Diffraction, Solid State Ionics, **46**, 243-247 (1991).
- J.R. Dahn, U. von Sacken and C.A. Michael, Structure and Electrochemistry of Li_{1+y}NiO₂ and a New Li₂NiO₂ Phase with the

Ni(OH)₂ Structure, Solid State Ionics, **44**, 87-97 (1990).

- Rosamaria Fong, U. von Sacken and J.R. Dahn, Studies of Li Intercalation into Carbons Using Non-Aqueous Electrochemical Cells, J. Electrochem. Soc., **137**, 2009-2013 (1990).
- U. von Sacken and J.R. Dahn, TGA/MS Studies of the Thermal Decomposition of NH₄VO₃, J. Power Sources, **26**, 461-465 (1989).

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 effectively 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 that 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 the 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. 12,278,330 B2 to Tao (“the ’330 patent”)
1002	Prosecution File History of U.S. Patent No. 12,278,330 B2 (“’330 File History”)
1005	U.S. Patent Pub. No. 2011/0111276 to Sato <i>et al.</i>
1006	Japanese Patent Pub. No. 2000-67907 to Takemura <i>et al.</i>
1007	Japanese Patent Pub. No. 2004-303950 to Kodama <i>et al.</i>
1008	Japanese Patent Pub. No. 2010-55906 to Kobayashi <i>et al.</i>
1009	Japanese Patent Pub. No. 10-326629 to Maejima <i>et al.</i>
1010	Japanese Patent Pub. No. 11-26008 to Yamauchi <i>et al.</i>
1011	Japanese Patent Pub. No. 2000-285902 to Mizutani <i>et al.</i>
1012	Japanese Patent Pub. No. 2003-068271 to Nakamura <i>et al.</i>
1013	Japanese Patent Pub. No. 2007-165224 to Yoneda <i>et al.</i>
1014	U.S. Patent Pub. No. 2006-0051662 to Kwak <i>et al.</i>
1015	U.S. Patent Pub. No. 2007-0172736 to Fujikawa <i>et al.</i>
1016	Japanese Patent Pub. No. 2008-171593 to Aoki <i>et al.</i>
1017	U.S. Patent Pub. No. 2010-0035144 to Oh <i>et al.</i>
1018	Korean Patent Pub. No. 2013-0085202 to Lee <i>et al.</i>
1019	Agubra <i>et al.</i> , “Lithium Ion Battery Anode Aging Mechanisms”
1020	Smart <i>et al.</i> , “Effects of Electrolyte Composition on Lithium Plating in Lithium-Ion Cells”
1021	Ratnakumar <i>et al.</i> , “Lithium Plating Behavior in Lithium-ion Cells”

Exhibit #	Description
1022	Eberman <i>et al.</i> , “Material and Design Options for Avoiding Lithium-Plating during Charging”
1023	Wen <i>et al.</i> , “A Review on Lithium-Ion Battery Safety Issues: Existing Problems and Possible Solutions”
1024	Complaint and Exhibit N filed in <i>Ningde Amperex Technology Ltd. V. Zhuhai CosMX Battery Co., Ltd.</i> , Case No. 2:24-ccv-728 (E.D. Tex.)
1025	Complaint and Exhibit 9 filed in <i>Ningde Amperex Technology Ltd. V. Zhuhai CosMX Battery Co., Ltd.</i> , Case No. 2:26-cv-00139 (E.D. Tex.)
1026	U.S. Patent Pub. No. 2011/0104539 to Oh <i>et al.</i>
1027	U.S. Patent Pub. No. 2004/0096735 to Komatsu
1028	Prosecution File History of U.S. Patent No. 11,923,498 B2 (“’498 File History”)
1029	Prosecution File History of Application No. 17/407,081 B2 (“’081 File History”)
1030	Prosecution File History of Application No. 16/113,938 B2 (“’938 File History”)
1031	Prosecution File History of U.S. Patent No. 10,541,441 B2 (“’441 File History”)
1033	U.S. Patent Pub. No. 2010/0178559 to Mao <i>et al.</i>
1034	U.S. Patent Pub. No. 2009/0305120 to Blomgren <i>et al.</i>
1035	U.S. Patent Pub. No. 2013/0101896 to Rich <i>et al.</i>
1036	U.S. Patent Pub. No. 2011/0136000 to Moon <i>et al.</i>
1037	U.S. Patent Pub. No. 2006/0003221 to Yeo
1038	U.S. Patent Pub. No. 2013/0244073 to Fujimoto

Exhibit #	Description
1039	Deposition Transcript of James Kaschmitter, February 20, 2026, in IPR2025-00389.
1040	U.S. Patent Pub. No. 2005/0003264 to Oh <i>et al.</i>
1042	U.S. Patent Pub. No. 2014/0120258 to Anderson
1043	U.S. Patent No. 6,423,446 to Miyazaki

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 1-20 of the '330 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-Kodama-Takemura	1-3, 6, 8, 10-13, 16, 18
2	Sato-Kodama-Takemura-Nakamura	4, 5, 7, 14, 15, 17
3	Sato-Kodama-Takemura-Kobayashi	9, 19, 20

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 '330 patent.

29. Based on my analysis of the '330 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

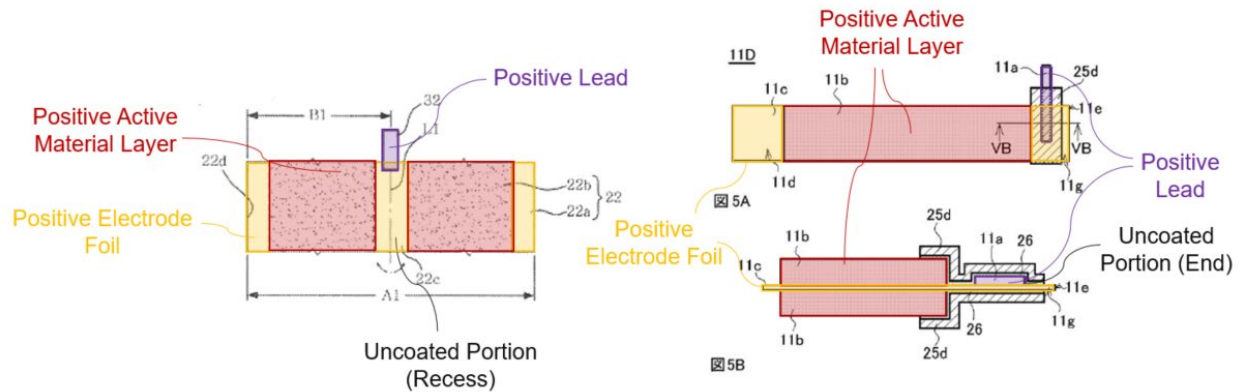
30. The '330 patent was filed on December 7, 2023, and claims priority, through multiple intervening applications, to Chinese Application No. 201420030319.4, filed on January 17, 2014. For purposes of my analysis here, I have been advised by counsel to assume a date of January 17, 2014, as the date governing my obviousness analysis.

VII. BACKGROUND OF CONVENTIONAL LITHIUM-ION BATTERY TECHNOLOGY

A. Fundamental structures of conventional lithium-ion batteries.

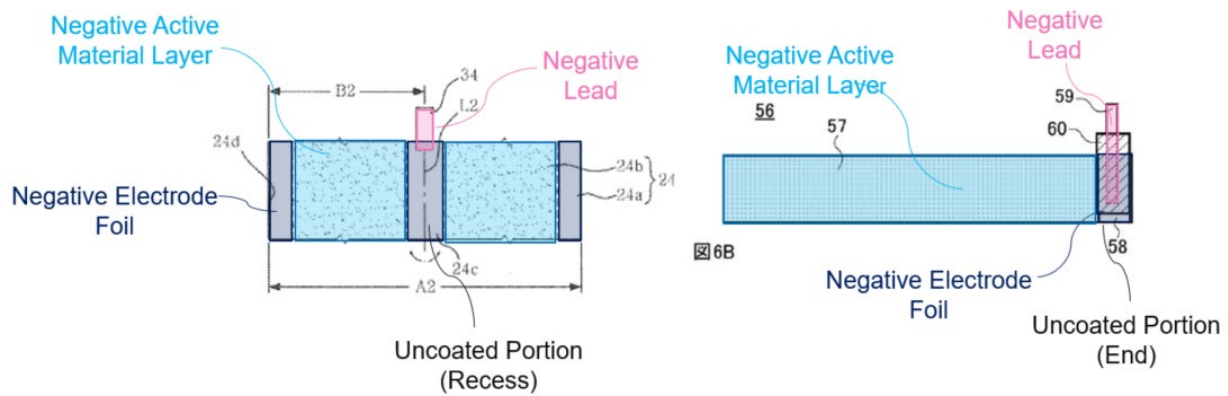
31. Conventional lithium-ion batteries have a cathode and an anode, a separator disposed between the cathode and the anode, and an electrolyte filling the pores of the cathode, anode, and separator and the spaces between them. EX1010, ¶¶[0018], [0021], [0022]; EX1013, ¶¶[0008], [0012], [0062]; EX1017, ¶[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. EX1026, ¶[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). EX1026, ¶¶[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. EX1026, ¶¶[0045]-[0046]; EX1008, ¶¶[0034], [0041], [0043]. The following annotated versions of Figures 2 and 5 from Exhibits 1026 and 1008, respectively, illustrate some conventional positive electrode constructions.



EX1026, 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. EX1026, ¶[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. EX1026, ¶¶[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. EX1026, ¶¶[0058]-[0059]; EX1008, ¶[0007]. The following annotated versions of Figures 3 and 6B from Exhibits 1026 and 1008, respectively, illustrate some conventional negative electrode constructions.

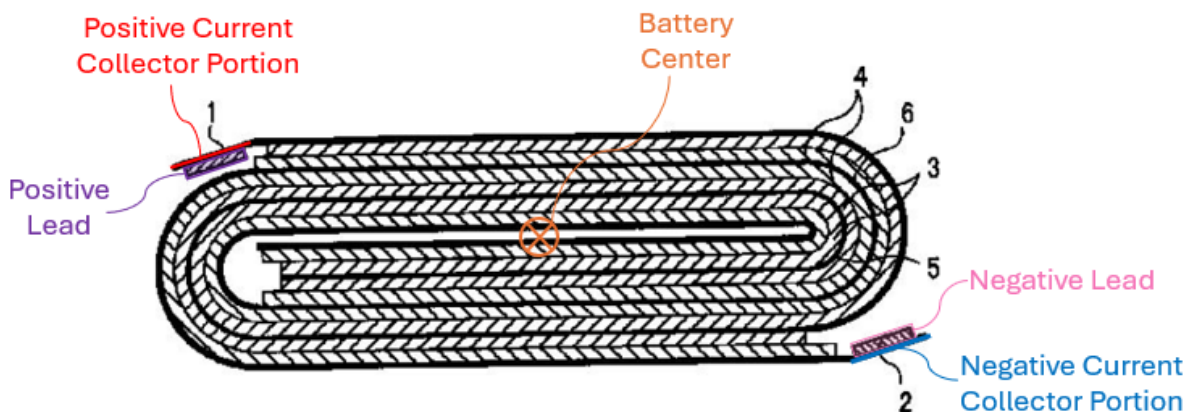


EX1026, FIG. 3 (annotated); EX1008, FIG. 6B (annotated).

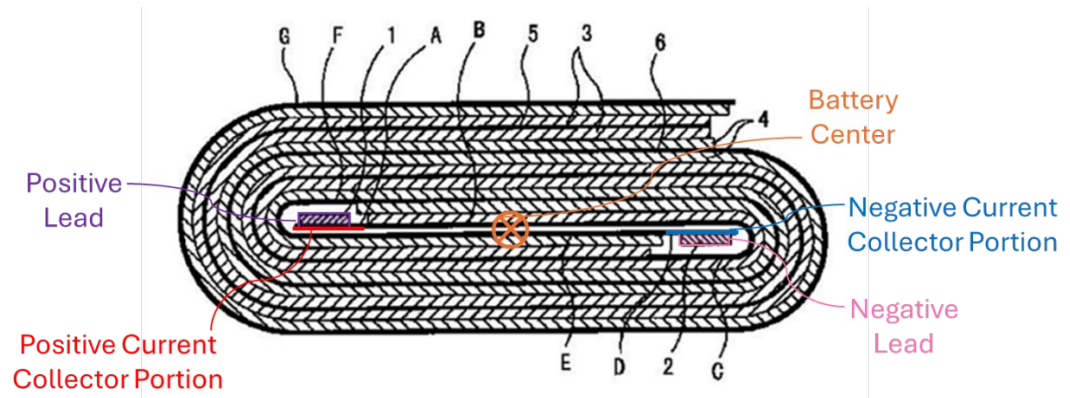
34. During charging, lithium ions are removed (deintercalated) from the cathode (positive) active material and migrate via the electrolyte across the porous separator membrane to the negative electrode where they are reabsorbed (intercalated) into the anode (negative) active material. EX1023, 199. During 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. Conventionally, a lithium-ion battery’s positive electrode, negative electrode, and separator are wound together in a “jelly-roll” like manner to, e.g., improve the battery’s energy density. EX1005, ¶[0004], [0097]; EX1006, ¶[0001]; EX1007, ¶[0003]-[0004]; EX1017, ¶[0012], [0026], [0032]; EX1035, ¶[0029]. As a result, a wound lithium-ion battery’s leads are oriented relative to the

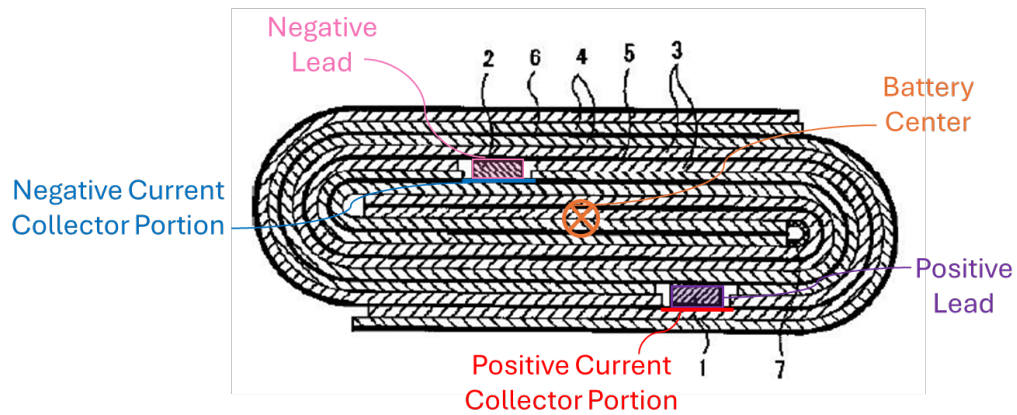
battery's center according to one of four possible configurations: (i) both the positive lead and the negative lead face toward the battery's center; (ii) both the positive lead and the negative lead face away from the battery's center; (iii) the positive lead faces toward the battery's center and the negative lead faces away from the battery's center; or (iv) the positive lead faces away from the battery's center and the negative lead faces toward the battery's center. *See* EX1006, FIGs. 1, 4, 5, 9. The following annotated versions of Figures 1, 4, 5, and 9 from Takemura illustrate each of these well-known possible configurations. A POSA would have understood that selecting any one of these four configurations is a matter of routine design choice dictated by layout preferences and the design of the winding machinery, without altering the electrochemical performance of the battery.



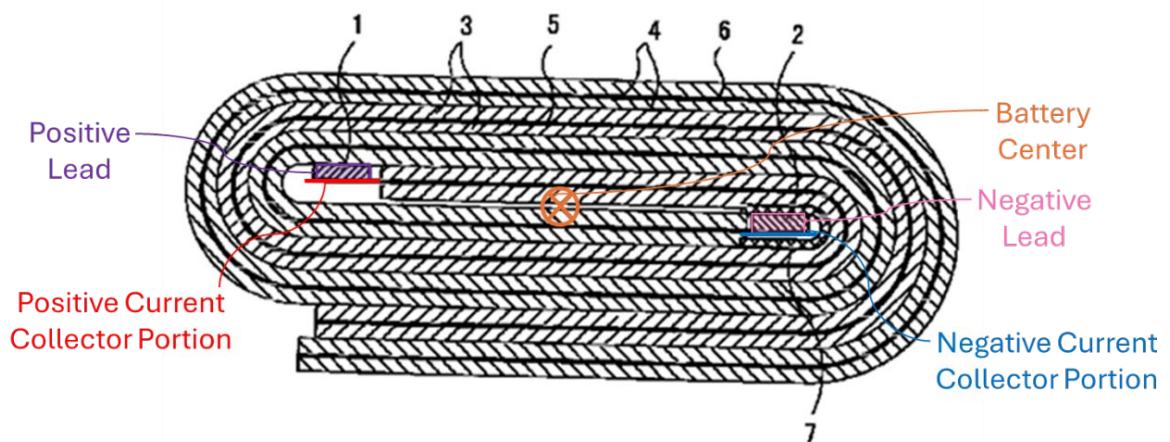
EX1006, FIG. 5 (annotated) (illustrating configuration (i) described above).



EX1006, FIG. 1 (annotated) (illustrating configuration (ii) described above).



EX1006, FIG. 4 (annotated) (illustrating configuration (iii) described above).



EX1006, FIG. 9 (annotated) (illustrating configuration (iv) described above).

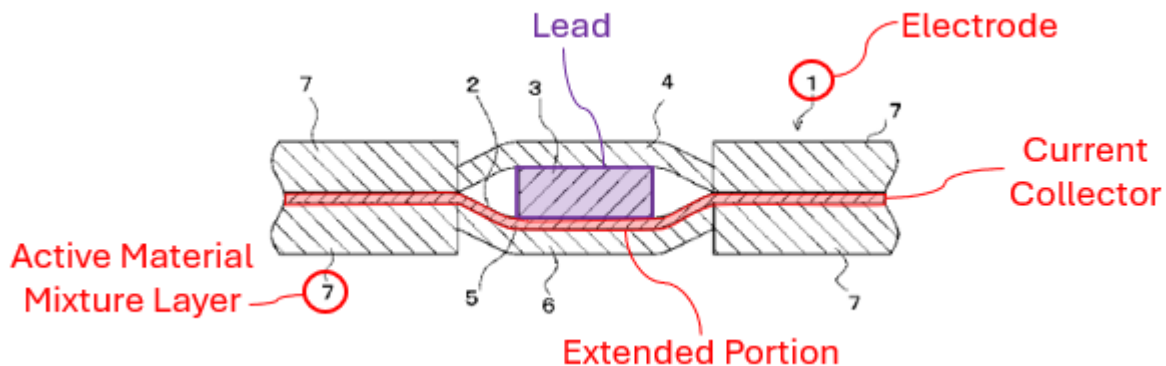
36. During winding of the battery's electrodes, contact between the leads and adjacent surfaces in the electrode stack frequently causes the current collectors' exposed portions to deflect away from the leads. EX1026, ¶[0039]; EX1040, ¶¶[0003], [0012]; *cf.* EX1007, ¶[0014].

B. Larger lead tabs improve conventional lithium-ion battery performance.

37. It has long been known that features and properties of the positive and negative lead tabs of a lithium-ion battery, and the manner to which they are attached to the battery's electrodes, affect the performance of the battery. EX1033, ¶[0002]; EX1034, Abstract, ¶¶[0013], [0059]; EX1035, ¶[0026]. For example, as current flows through the positive and negative lead tabs of a lithium-ion battery, the tabs heat—causing the electrical resistances of the tabs to increase. EX1033, ¶[0002]. In this manner, the current flowing through the tabs and the output voltage of the battery decrease as, e.g., the battery is discharged, leading to decreased battery performance. EX1033, ¶[0002]. For this reason, it has long been a goal of lithium-ion battery design to include larger lead tabs (e.g., thicker lead tabs) to minimize the internal electrical resistance of the battery. *Cf.* EX1033, ¶[0002]; EX1036; ¶[0077] (“[I]t is preferable to form the positive electrode current collecting tab 35 with a relatively large thickness in order to reduce resistance” to current flow). Larger lead tabs (e.g., thicker lead tabs) are also beneficial to extend durability and minimize the risk of tab breakage. EX1035, ¶[0026].

38. The desirability of increasing the size (e.g., the thickness) of lithium-ion battery lead tabs, however, is in tension with other goals of lithium-ion battery design. For example, a lead tab that extends beyond a boundary of its corresponding active material layer can create undesirable irregularities along the electrode's profile. EX1007, ¶[0014]; *cf.* EX1007, ¶¶[0017]-[0018]; EX1037, ¶[0008] (“the wound regions corresponding to the conductive tabs and the insulation tape are substantially thicker than the remaining wound regions,” which “makes the insertion of the electrode assembly difficult, sometimes causing the protruding portions to deform.”) Such irregularities may, e.g., create stress when the electrodes of the battery are wound during manufacturing or are otherwise subject to external forces. EX1005, ¶[0024]; EX1037, ¶[0008]. For this reason, the tab thickness is normally chosen to be less than the thickness of the coating on one side of the electrode. *See* EX1005, FIG. 3; EX1006, FIG. 8, EX1008, FIG. 2B; EX1011, FIG. 3; EX1013, FIGs. 3-4; EX1014, FIG. 3; EX1015, FIG. 1. The thickness of lithium-ion electrode coatings is constrained by ion transport and diffusion considerations. In practice, electrode coatings are optimized to achieve acceptable discharge rates and to prevent lithium plating during charging. As a result, increasing the coating thickness merely to accommodate a thicker tab would significantly degrade battery performance and is therefore not a practical design option.

39. A known approach that nearly doubles the space available for the tab was to allow an exposed portion of a battery's current collector to indent or deflect in a direction opposite the lead tab-attachment surface, as shown below. EX1007, ¶[0026]-[0028], FIGs. 3A-D. Such configurations provide additional space for a larger lead tab, while also ensuring that the larger lead tab does not increase the local thickness of its corresponding electrode. Accordingly, indenting the exposed portion of the current collector to attach a thicker lead tab improves the battery's current flow, output voltage, and mechanical reliability.



EX1007, FIG. 3 (annotated).

C. Insulating tape(s) prevent lithium-plating and/or short-circuiting within conventional lithium-ion batteries.

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

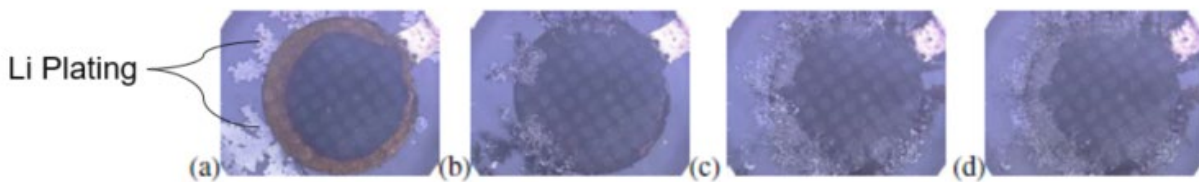
41. If the local anode capacity is insufficient to absorb the lithium ions released by the cathode during the charging, then they will electroplate as lithium metal. EX1019, 1317; EX1020, 379; EX1021, 242; EX1023, 201. The plated lithium metal tends to grow toward the cathode as a branching, “dendritic” 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 the battery. EX1023, 201.

42. It was known that any exposed metal on the negative electrode that is located opposite to positive electrode active material is susceptible to lithium

¹ In the art, “lithium plating” can also be referred to as “lithium deposition” or “lithium precipitation.”

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, 47, 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.

43. 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.



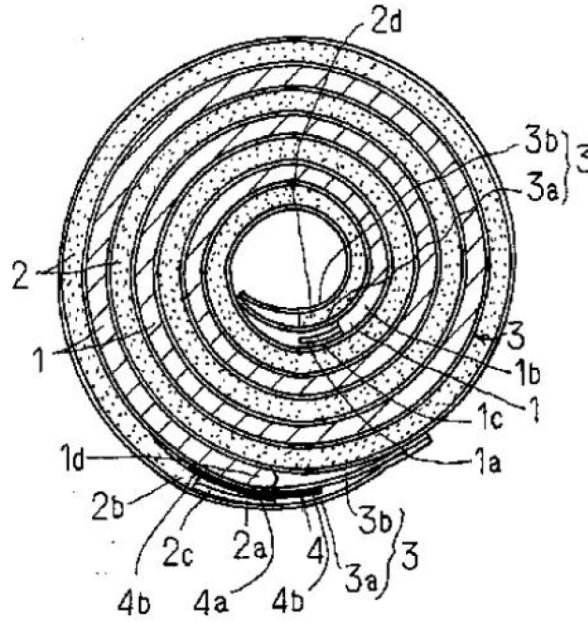
EX1022, FIG. 6 (annotated).

44. 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.

45. 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].



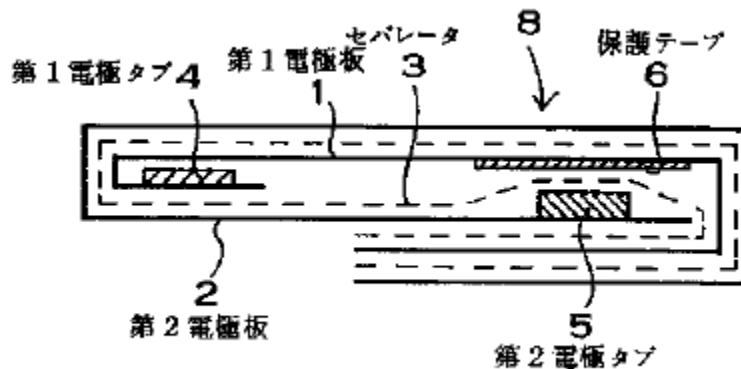
EX1009, FIG. 1.

46. 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].

47. 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].

48. 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].



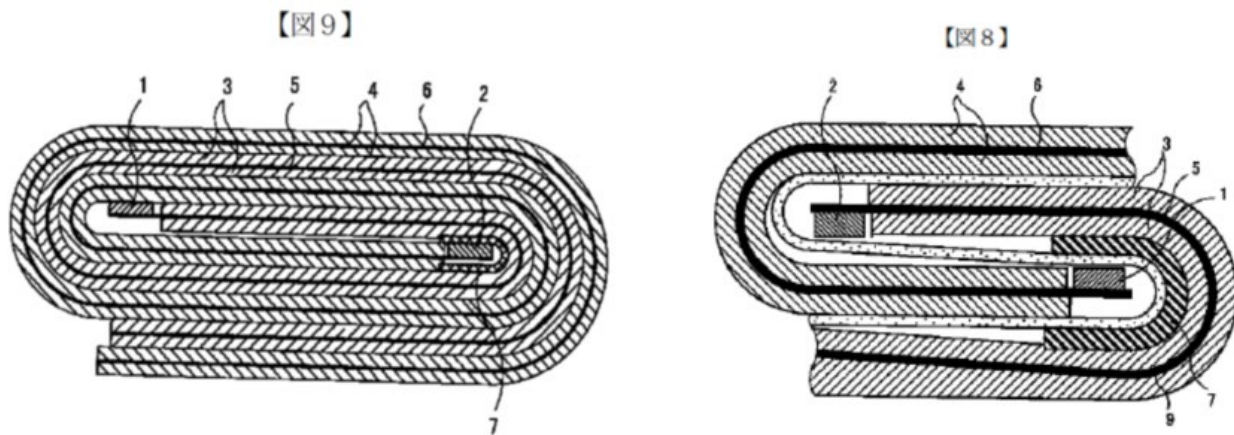
EX1010, FIG. 4.

49. 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].

50. 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 8² (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."

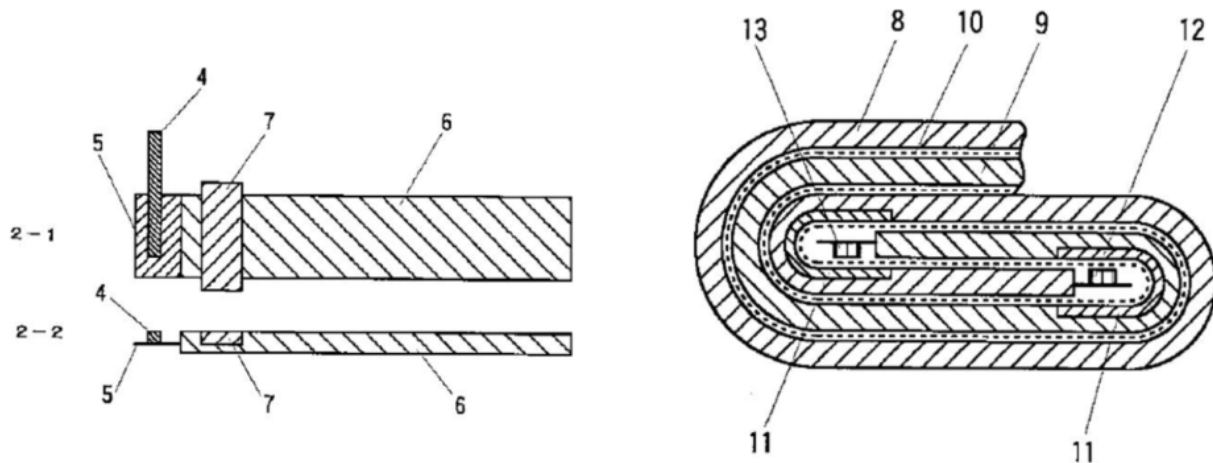


EX1006, FIGs. 9, 8.

51. 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].

52. 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].

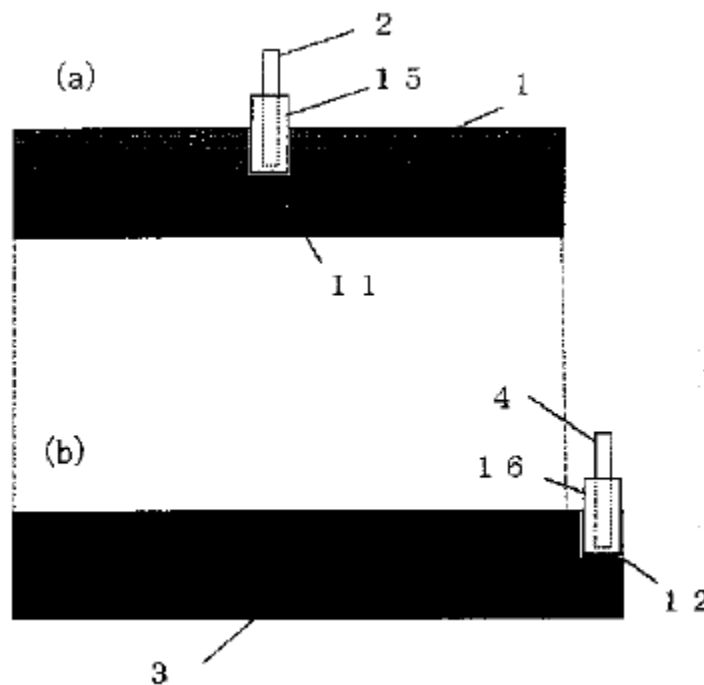


EX1011, FIGs. 2, 3.

53. 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].

54. 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

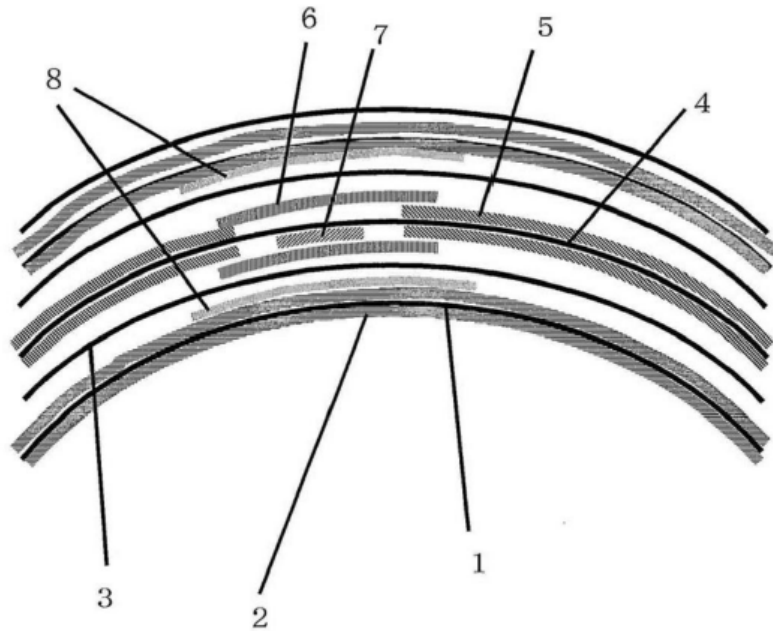
welded to a positive electrode active material-free portion 11, and (ii) a negative electrode plate 3 with a negative electrode lead 4 welded to a negative electrode active material-free portion 12. EX1012, ¶¶[0024]-[0027]. Nakamura placed insulating tapes 15 and 16 such that the tapes covered the positive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



EX1012, FIG. 1.

55. 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.

56. 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 facing the uncoated portions on the positive electrode current collector 4. EX1013, ¶¶[0008]-[0009], [0012], [0014], and FIG. 4.

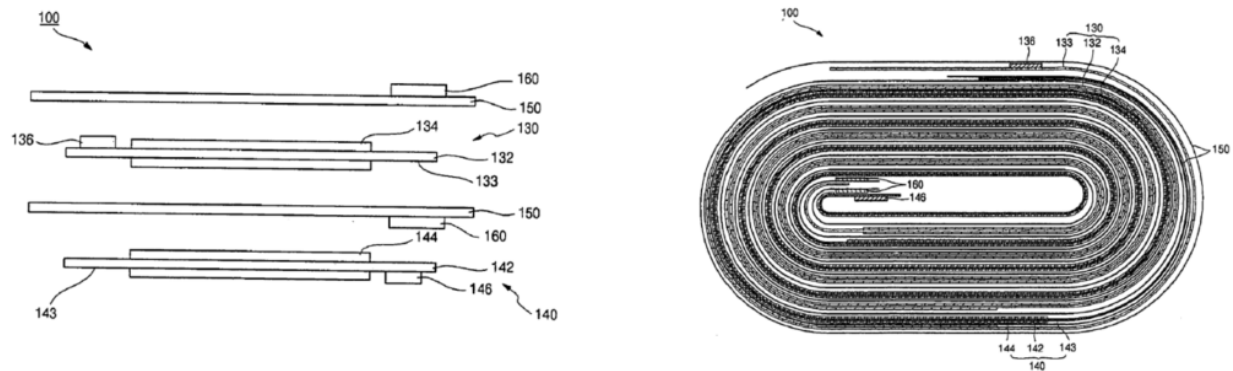
57. Yoneda positioned the tapes 6 and films 8 around the positive

electrode lead 7 to suppress heat generation during an internal short circuit, and thereby improve the battery's safety performance. EX1013, ¶¶[0007], [0011].

58. Kwak *et al.* (US 2006-0051662; EX1014) were also investigating selective application of 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 when heat is generated. EX1014, ¶¶[0041], [0042], [0048], [0049], [0054], [0057], [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].

59. 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].



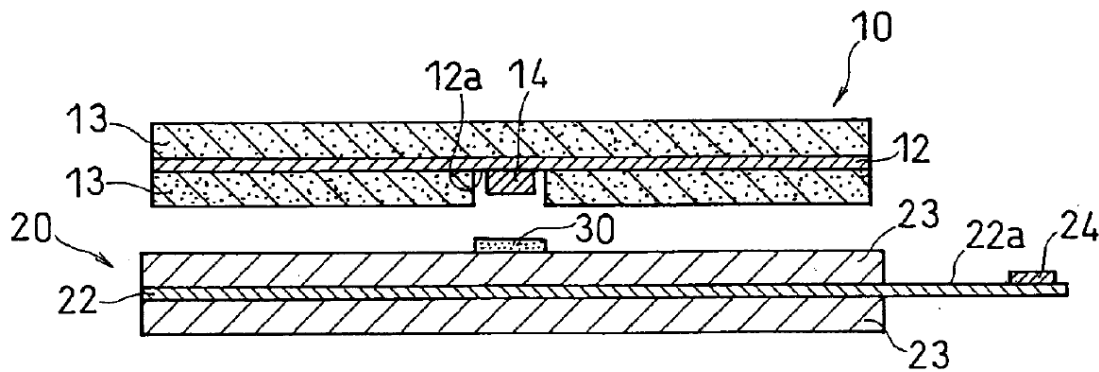
EX1014, FIGs. 4, 5.

60. 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].

61. 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

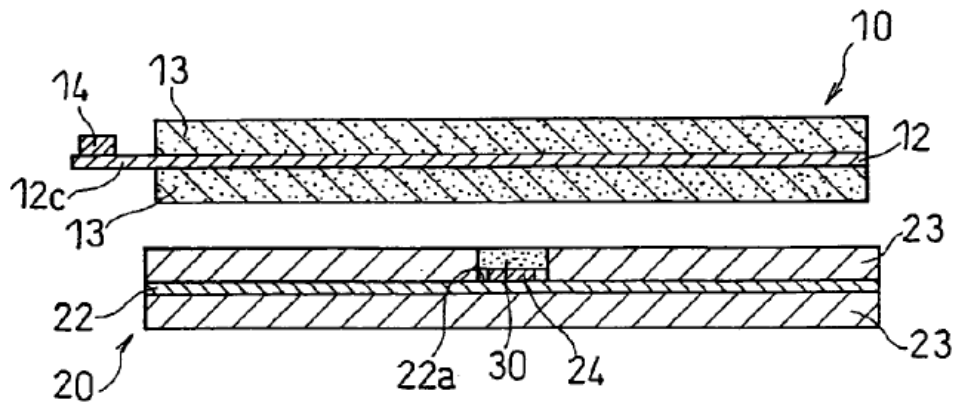
of the length of the electrodes reduced the “electrical resistance of the electrode” to “offer high output power.” EX1015, ¶24.

62. 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

63. 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.

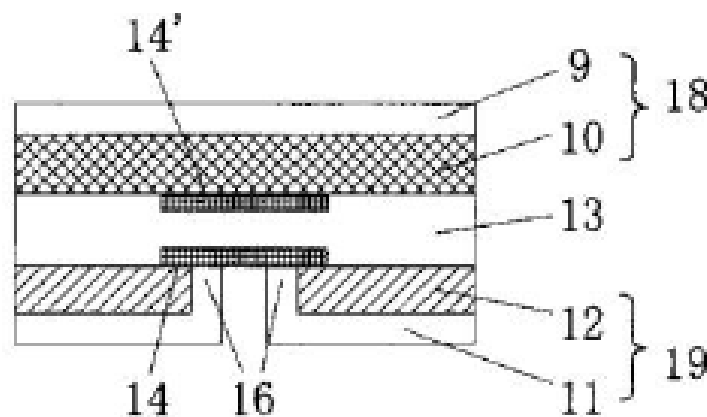
64. Fujikawa also explained that in an alternative embodiment to that shown in Figure 4, the battery was “produced in the same manner as [shown in FIG. 4] except that the first heat resistant layer 30 was formed on the positive electrode 10 such that the first heat resistant layer faced the center exposed 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.

65. 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.

66. 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.

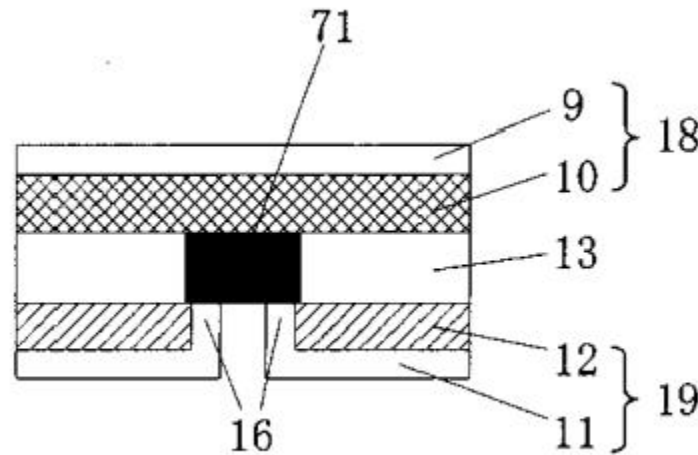
67. Figure 6 of Aoki (reproduced below) shows a conventional method of using insulating seal tape 14’ specifically to prevent lithium plating. EX1016, ¶12. The insulating seal tape 14’ covered “the positive electrode layer that is opposite to the negative electrode coated portion via a separator.” EX1016,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



EX1016, FIG. 6.

68. 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) shows this battery design with the insulating composition 71.



EX1016, FIG. 7.

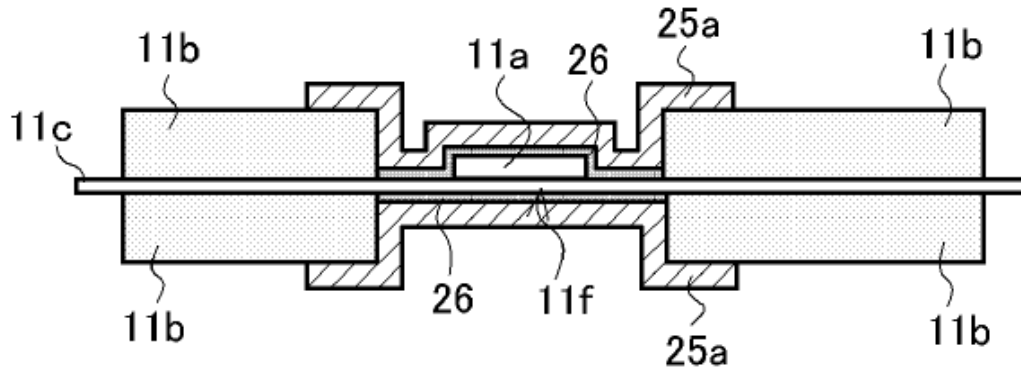
69. Aoki's battery included: (i) a positive electrode 18 with a positive electrode current collector 9 and positive electrode active layer 10, (ii) a negative electrode 19 with a negative electrode active layer 12 and negative electrode current collector 11 having an exposed metal portion 16, and (iii) 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.

70. 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, ¶29.

71. 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.

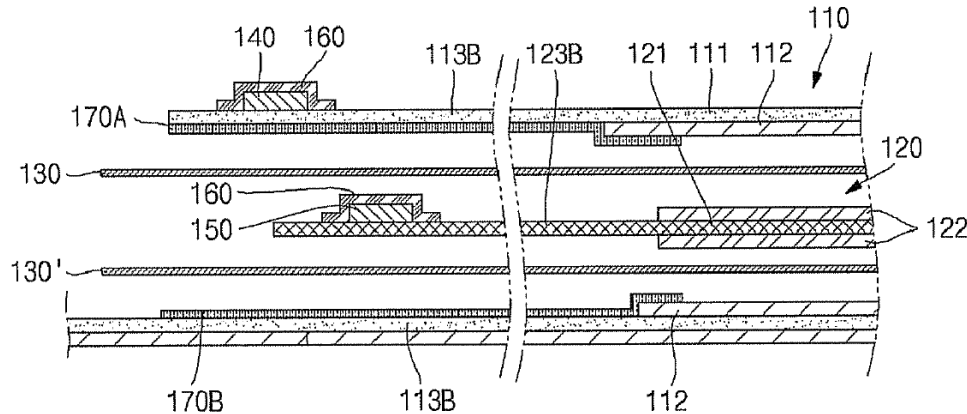


EX1008, FIG. 2A.

72. 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.

73. 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.



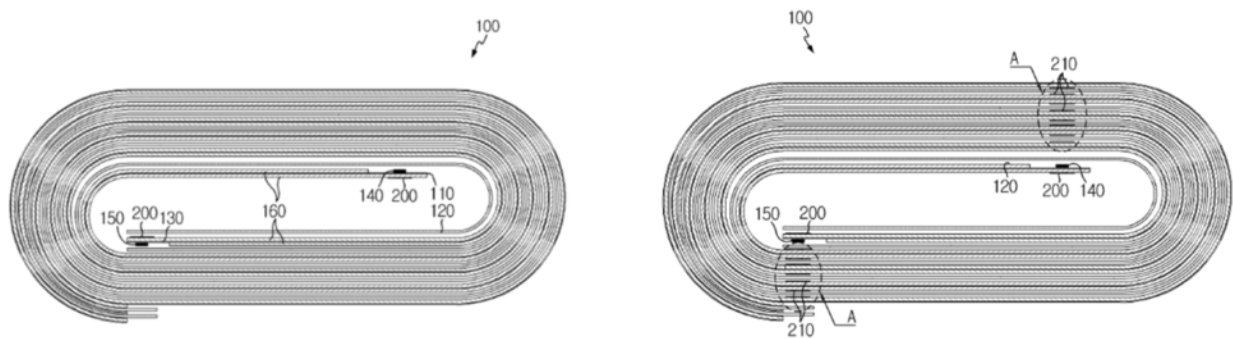
EX1017, FIG. 4.

74. 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].

75. 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].

76. 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.

77. 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].

78. 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. THE '330 PATENT

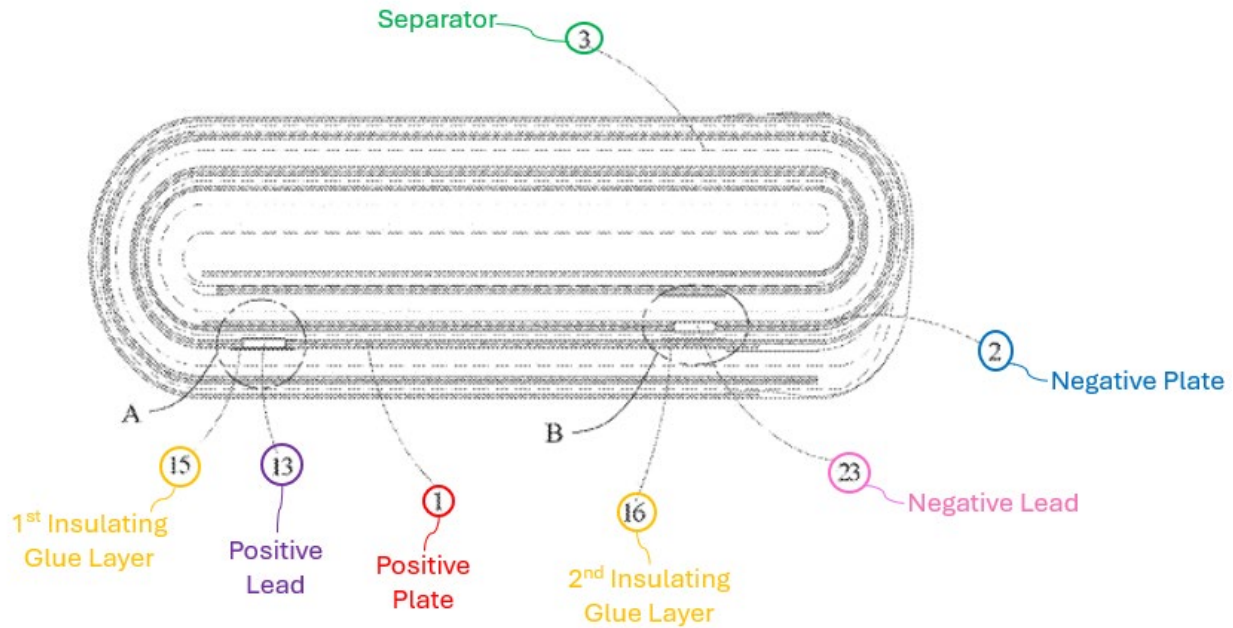
A. Summary of the '330 patent

79. The '330 patent was filed as Application No. 18/532,841 on

December 7, 2023. The '330 patent is the fourth continuation in a chain of patents that claim priority to Chinese App. No. 201420030319.4. EX1001, cover (63). In particular, the '330 patent is a continuation of Application No. 17/746,755, filed on May 17, 2022 (now U.S. Patent No. 11,923,498), which 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), which claims priority to Chinese App. No. 201420030319.4, filed on January 17, 2014. EX1001, 1:7-24.

80. The '330 patent is titled "Lithium-ion Battery Having Desirable Safety Performance" and lists Tao Tao and Ming Liang Mo as inventors. EX1001, cover page (54), (72).

81. The claims of the '330 patent are directed to lithium-ion batteries. EX1001, 10:46-12:63. The '330 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, 5:8-12.



EX1001, FIG. 5a (annotated).

82. Figures 1 and 2 below depict the '330 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, 5:12-14. 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, 5:18-19. First recess 14 is positioned at a midpoint of positive plate 1. EX1001, 5:33-42. The positive lead 13 is connected to the positive current collector 11 via a recess 14 in the positive film 12.

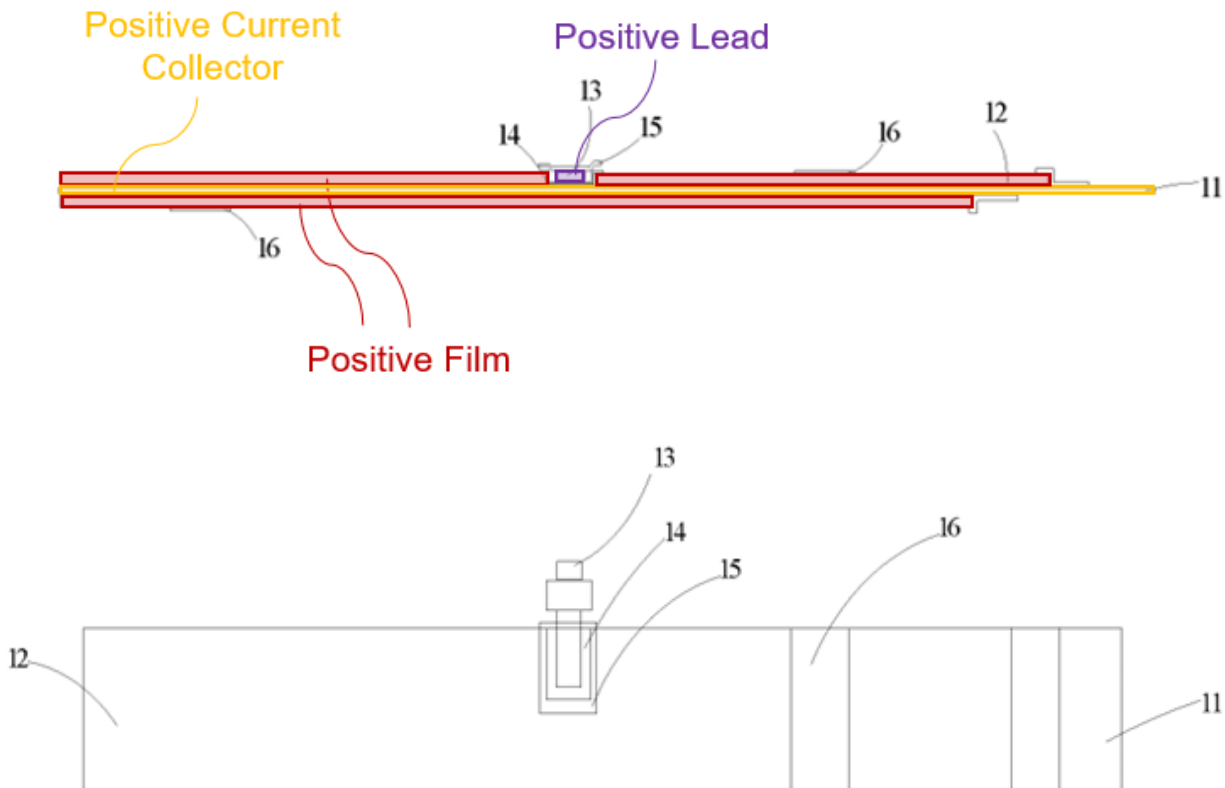


FIG. 2

EX1001, FIGs. 1, 2.

83. Figures 3 and 4 below depict the '330 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, 5:14-17. 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. EX1001, 5:19-20. Second recess 24 is positioned at a midpoint of negative plate 2. EX1001, 5:33-42.

A negative lead 23 is connected to the negative current collector 21 via recess 24 in the negative film 22. EX1001, 5:21-26.

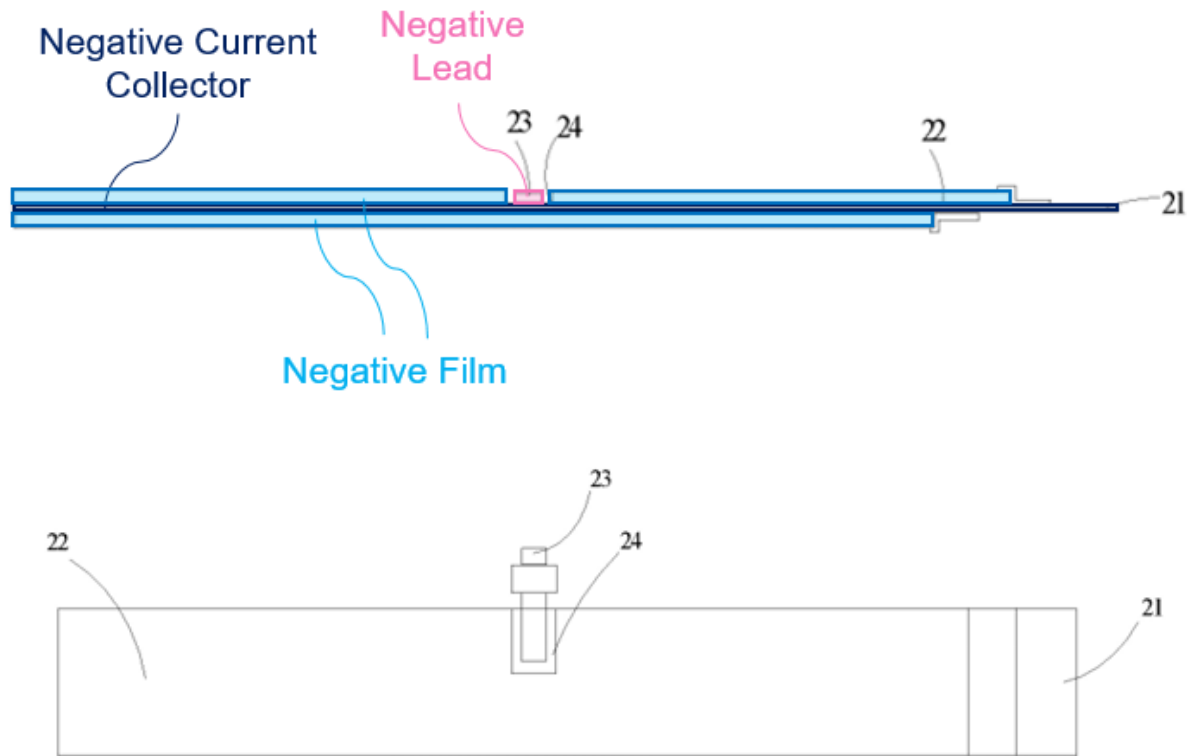
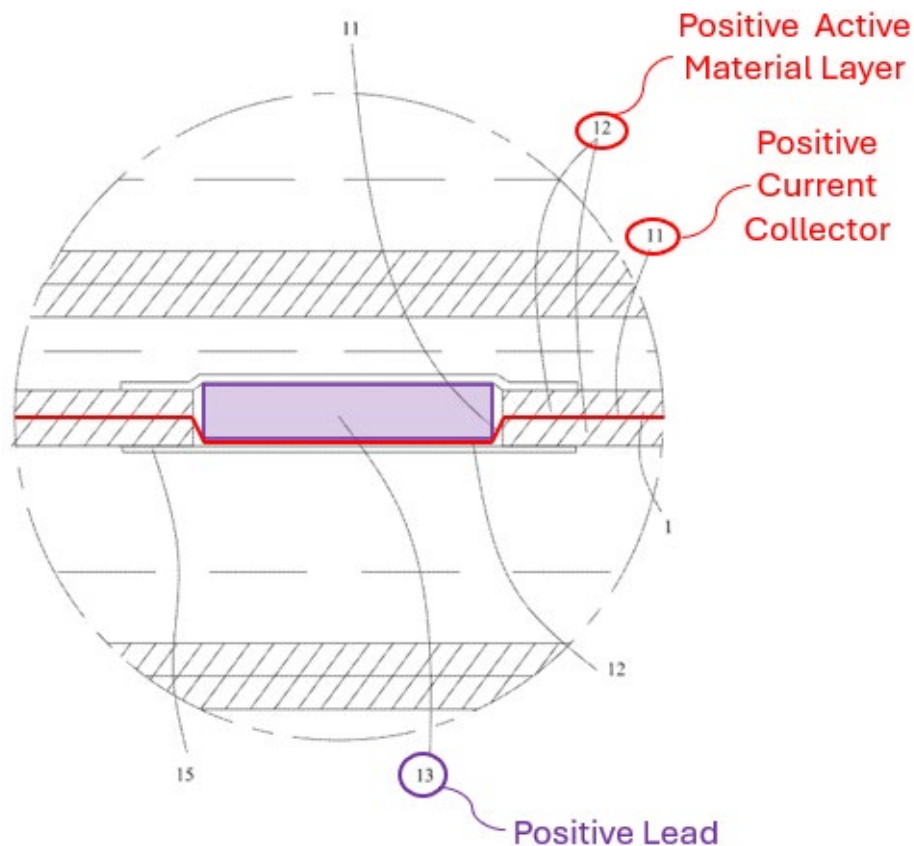


FIG. 4

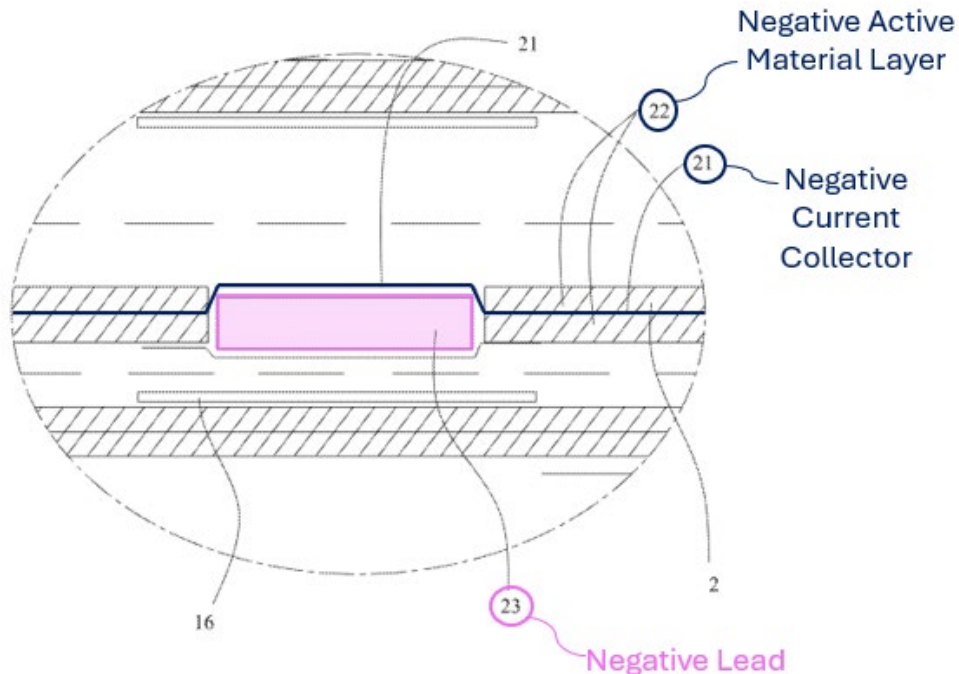
EX1001, FIGs. 3, 4.

84. The '330 patent shows enlarged views of the lead connection to the electrodes in Figures 5B and 5C that were not included in the drawings of the parent applications of the '330 patent. Figure 5B shows positive lead 13 connected to a surface of positive current collector 11 facing the battery's center, where the exposed portion of positive current collector 11 extends away from the battery's

center. EX1001, FIG. 5B. Figure 5C shows negative lead 23 connected to a surface of negative current collector 21 facing away from the battery's center, where the exposed portion of negative current collector 21 extends toward the battery's center. EX1001, FIG. 5C. As I discussed in Section VII, this simple technique for accommodating lead tabs in electrodes—exposed portions of the current collectors extending in a direction opposite to the current collector surface connected to the lead tab—was well known. *See e.g.*, EX1007, ¶¶[0015], [0018], [0028].



EX1001, FIG. 5B (annotated).



EX1001, FIG. 5C (annotated).

85. Furthermore, the '330 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, 1:63-2:4. As shown in Figures 1, 2, and 5B, reproduced above, a first insulating glue layer 15 is applied over the positive lead 13, recess 14, and positive film 12. EX1001, 5:21-24. As shown in Figure 2, reproduced above, 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. EX1001, 5:24-26. The '330 patent states that, by applying insulating layers within the battery, internal short-circuiting and lithium precipitation can be prevented. EX1001, 3:62-4:3. The '330 patent seeks to

prevent these internal short circuits and lithium precipitation by placing standard insulating layers in the battery coil. EX1001, 3:62-4:3.

86. When the current collectors 1, 2 are coiled in the '330 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 '330 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, 3:13-16.

87. The use of insulating layers as described in the '330 patent was a common technique employed in the industry to address the well-known problem of lithium plating and short-circuiting. 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, ¶¶[0117]-[0118]; EX1016, ¶[0028]; EX1008, ¶[0005]; EX1017, ¶¶[0037]-[0039].

B. Prosecution History of the '330 patent

88. The application that issued as the '330 Patent was filed as U.S. Patent Application No. 18/532,841 (the '841 Application) on December 7, 2023. EX1002, 322-68. Original claims 1-20 were similar to the issued (and presently challenged) claims. EX1002, 359-363.

89. The U.S. Patent and Trademark Office (“the Office” or “USPTO”) issued a first (and only) non-final Office Action on August 6, 2024, rejecting independent claims 1 and 11 (as well as claims 3, 8, 13, and 18) as anticipated by JP 2014-225326 to Sugita. EX1002, 58-68. Claims 6, 9, 10, 16, 19, and 20 were rejected as obvious over various combinations of Sugita, US 2012/0052331 to Park, and US 2006/0051662 to Kwak *et al.* EX1002, 65.

90. After an Examiner interview on November 4, 2024, Applicant responded to the non-final Office Action by making only minor, editorial amendments to independent claims 1 and 11. EX1002, 44-54. Applicant argued that Sugita fails to disclose or suggest “a portion of the negative current collector where the negative lead is disposed extends towards the center of the battery.” EX1002, 51. Applicant further argued that Sugita’s negative electrode includes an active substance layer on the side of the negative current collector opposite the negative tab, which allegedly prevents the negative current collector from extending toward the center of the battery as claimed. EX1002, 52.

91. The Office subsequently issued a Notice of Allowance, noting the cited art disclosed “anode and cathode leads” that “are disposed on current collector surfaces that extend towards and face away from the center of the battery” yet “there is no teaching or suggestion of accommodating recesses that would correspond to such positions or be combined with such positions as required

by the claims.” EX1002, 20. But portions of current collectors extending away from or toward a battery’s center to accommodate a lead tab was known, as I explain herein. EX1007, ¶¶[0026]-[0028].

92. The ’330 patent subsequently issued on April 15, 2025. EX1002, 2.

C. ’330 patent Claims

93. Independent claims 1 and 11 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 lithium cobalt oxide, wherein the positive electrode active material layer is formed on the positive current collector, and the positive electrode active material layer is 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; and the negative lead is disposed on a surface of the negative current collector facing away from the center of the battery; and a portion of the negative current collector where the negative lead is disposed extends towards the center of the battery;

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

an electrolyte.

11. 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, wherein the positive electrode active material layer is 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, wherein the negative electrode active material layer is provided with a second recess accommodating a negative lead being coupled with the negative current collector; and

the negative lead is disposed on a surface of the negative current collector facing away from the center of the battery; and

a portion of the negative current collector where the negative lead is disposed extends towards the center of the battery;

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

an electrolyte.

IX. GROUND 1: CLAIMS 1-3, 6, 8, 10-13, 16, and 18 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO, TAKEMURA, AND KODAMA.

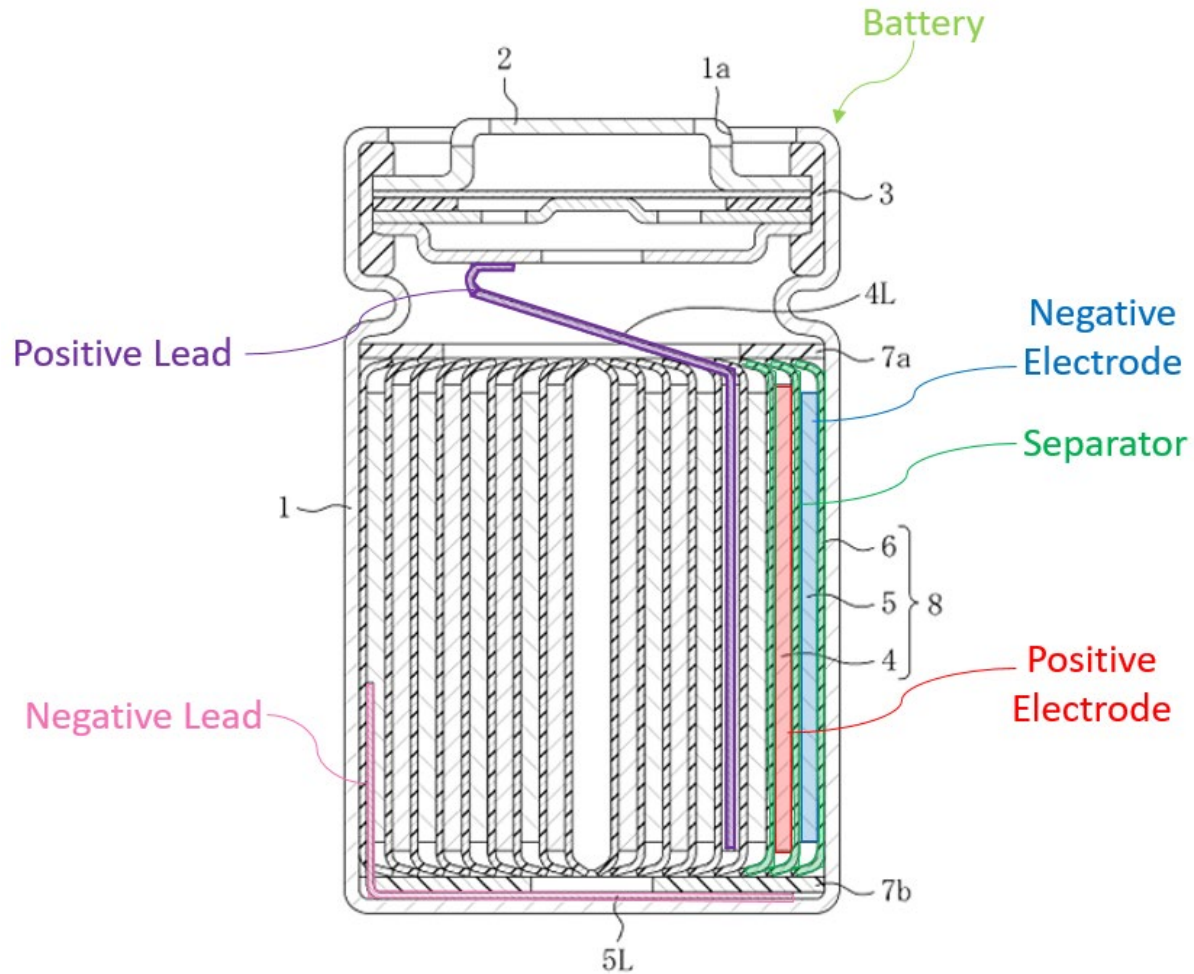
A. U.S. Patent Pub. No. 2011/0111276 to Sato *et al.* (Sato)

94. 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 '330 patent's earliest effective filing date of January 17, 2014, by almost three years, and its international filing date precedes the '330 patent's filing date by almost four years.

95. Sato discloses a Li-ion battery containing similar materials as claimed in the '330 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].

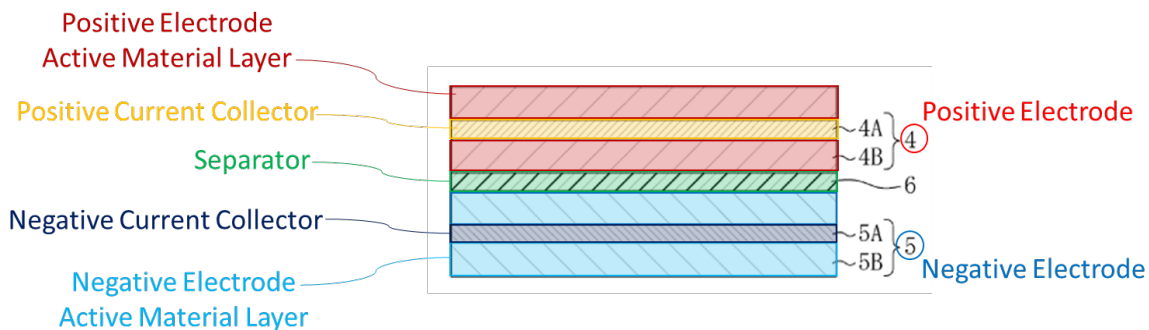


EX1005, FIG. 1 (annotated).

96. 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].

97. Similarly, 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].

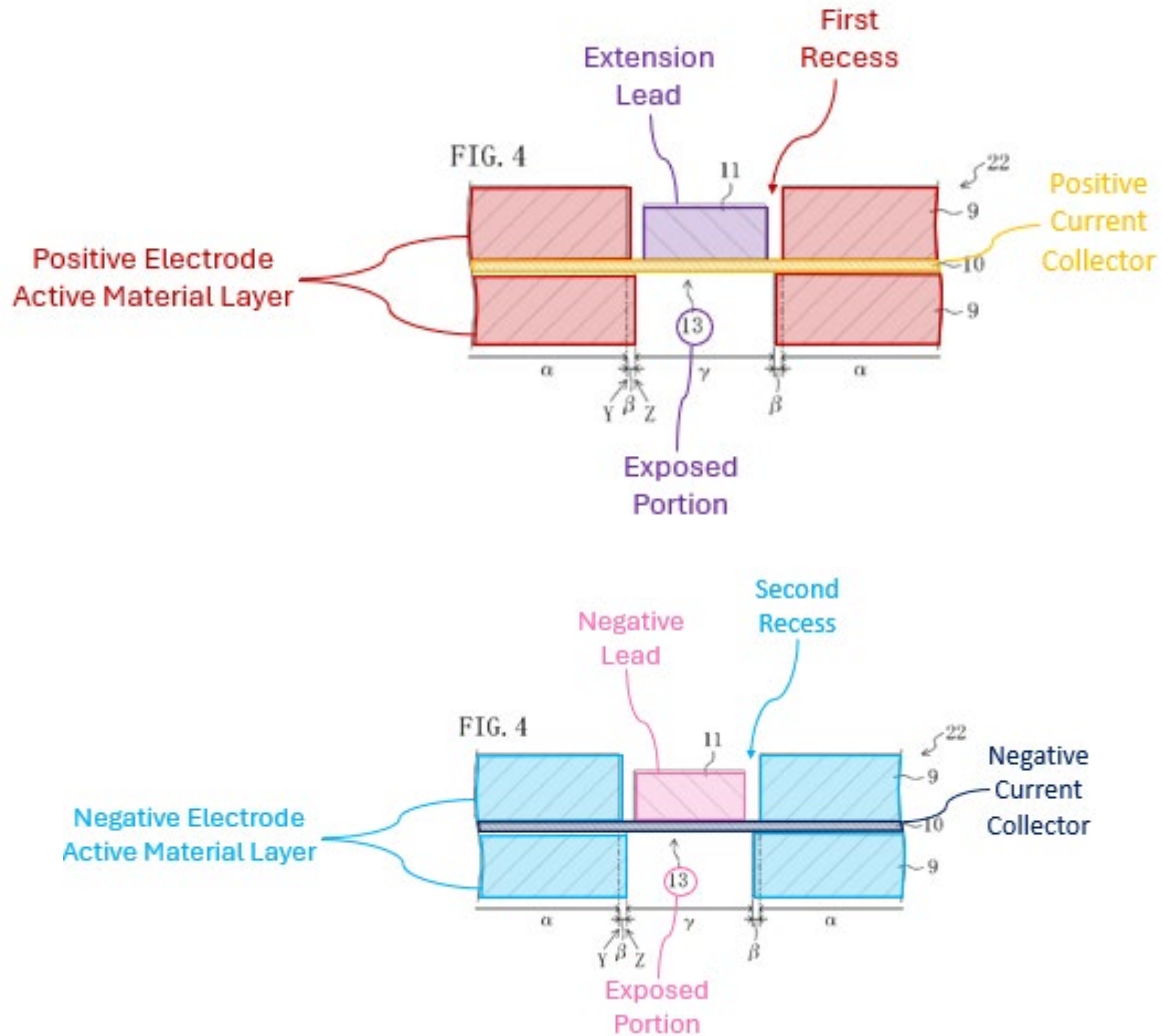


EX1005, FIG. 2 (annotated).

98. Sato discloses that "at least one of the positive electrode plate 4 and the negative electrode plate 5" defines a recess where "the mixture layer is not formed on one surface of the current collector connected to the lead (i.e., a first surface) and on the other surface (i.e., a second surface) of the current collector." EX1005, ¶[0036]; *see also* EX1005, ¶[0036]. In this manner, the recess defined by the positive electrode plate 4 accommodates Sato's positive lead 4L, thereby

allowing it to be welded to the “exposed portion” 13 of Sato’s positive electrode current collector 4A that is not formed with the mixture layer. Similarly, the recess defined by the negative electrode plate 5 accommodates Sato’s negative lead 5L, thereby allowing it to be welded to the exposed portion 13 of Sato’s negative electrode current collector 5A that is not formed with the mixture layer. Figure 4 of Sato (reproduced and annotated below) illustrates this concept of connecting a lead 11 to one of the surfaces of an exposed portion 13 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 Figure 4 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. 4 (annotated).

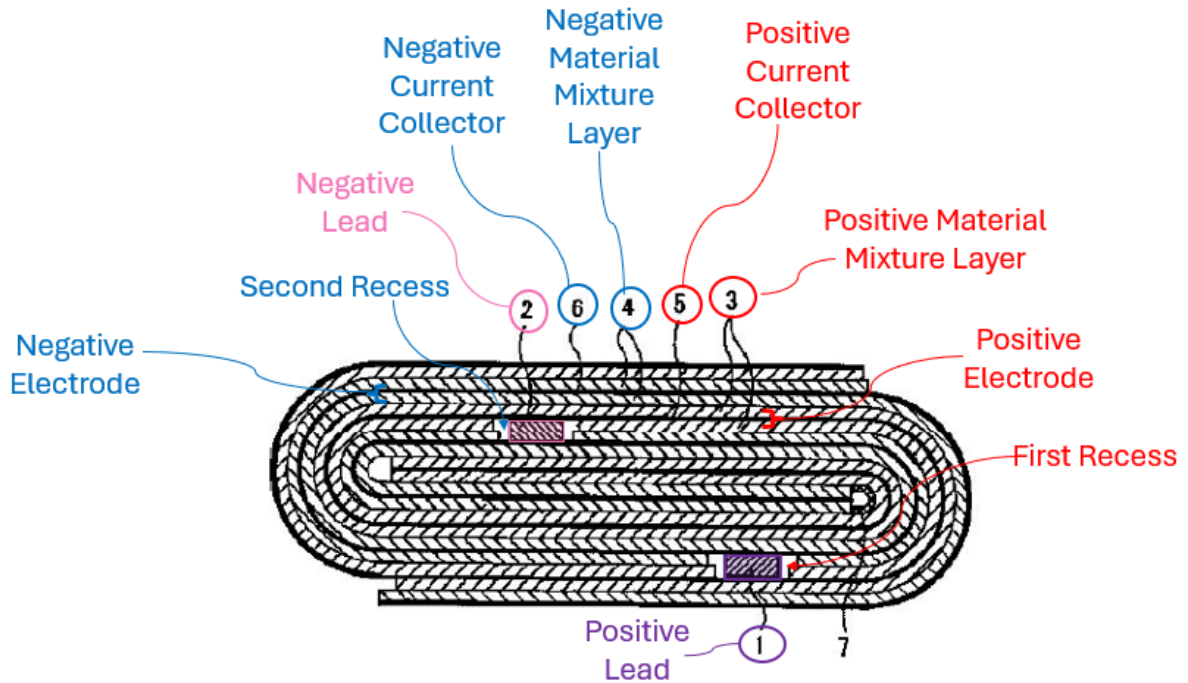
99. Sato further describes protecting and insulating the leads 11 with polypropylene and polyethylene adhesive tapes. EX1005, ¶[0113]. Sato also discloses placing an additional insulating tape on “the positive electrode surface facing the negative electrode lead . . . in order to prevent lithium deposition.” EX1005, ¶[0137]. According to Sato, this additional insulating tape is attached to a portion of the positive electrode active material layer (4B/9). EX1005, ¶[0148]

(explaining that “a portion of the positive electrode active material which should originally operate is insulated by a tape.”).

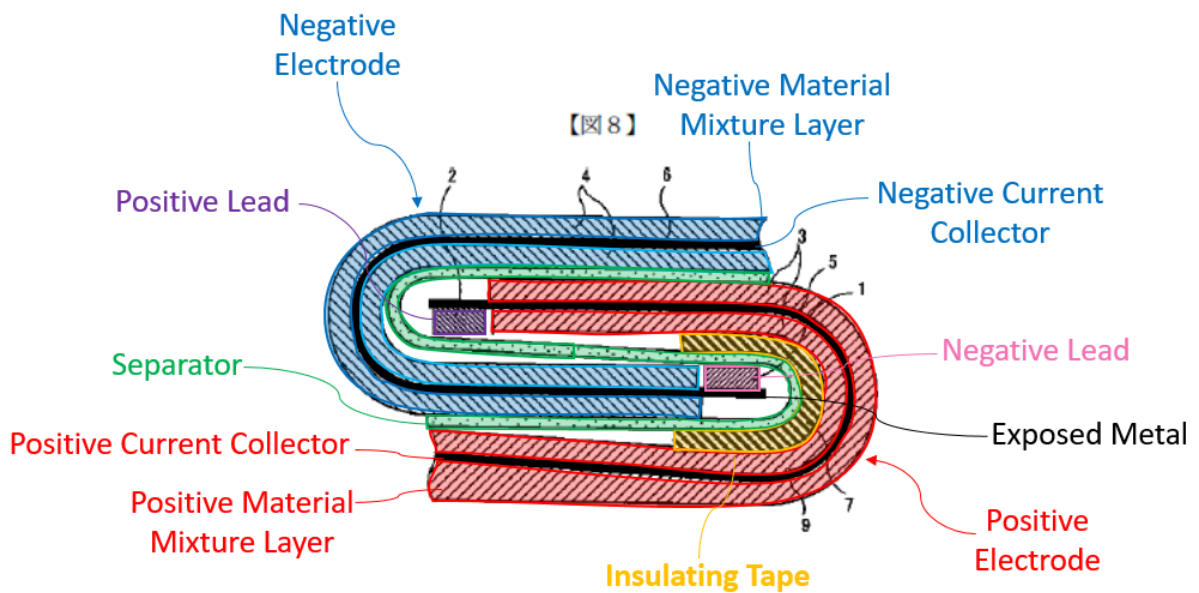
**B. Japanese Patent Pub. No. 2000-67907 to Takemura *et al.*
(Takemura)**

100. Japanese Patent Pub. No. 2000-067907 to Takemura *et al.* published on March 3, 2000. Takemura’s publication date precedes the ’330 patent’s earliest effective filing date of January 17, 2014, by almost 14 years.

101. Takemura discloses multiple battery embodiments with similar fabrication attributes as those described in Sato and the ’330 patent. EX1006, ¶[0003], FIGs. 4, 8-9. In each of its embodiments, 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 and 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], [0022], FIGS. 4, 8-9. In each of its embodiments, Takemura’s battery includes a separator (annotated in Figure 9 below) impregnated with a non-aqueous electrolyte and interposed between the positive electrode active material 3 and negative electrode active material 4. EX1006, ¶¶[0003], [0022] (separator not shown in Figure 4 embodiment “to avoid complicating the figure.”).



EX1006, FIG. 4 (annotated).



EX1006, FIG. 8 (annotated).

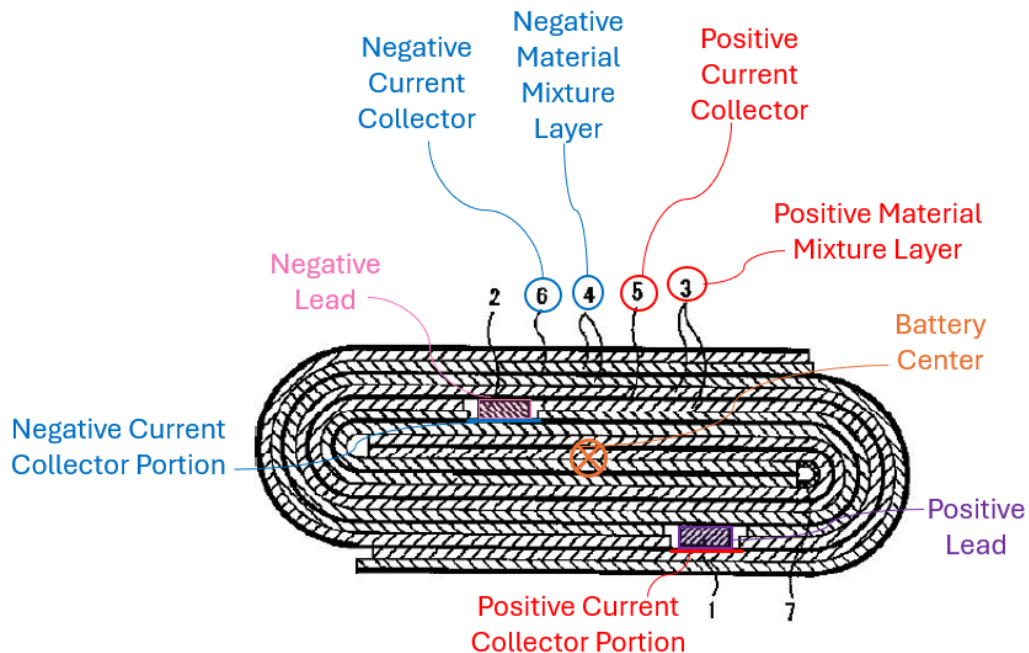
102. In each of its embodiments, Takemura's lithium-ion battery further includes a positive electrode current collector terminal (lead) 1 connected to the

positive current collector 5 and a negative electrode current collector terminal (lead) 2 connected to the negative current collector 6. EX1006, ¶¶[0006], [0007], [0022]. 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].

103. Takemura discloses similar fabrication attributes as Sato and the '330 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].

104. In the battery embodiment shown in Figure 4, reproduced below, Takemura further describes and illustrates its positive electrode current collector terminal (lead) 1 being disposed on a surface of the positive current collector 5 that faces toward a center of Takemura's battery. EX1006, ¶[0022], FIG. 4.

Furthermore, Takemura describes and illustrates its negative electrode current collector terminal (lead) 2 being disposed on a surface of the negative current collector 6 that faces away from the center of Takemura's battery. EX1006, ¶[0022], FIG. 4.

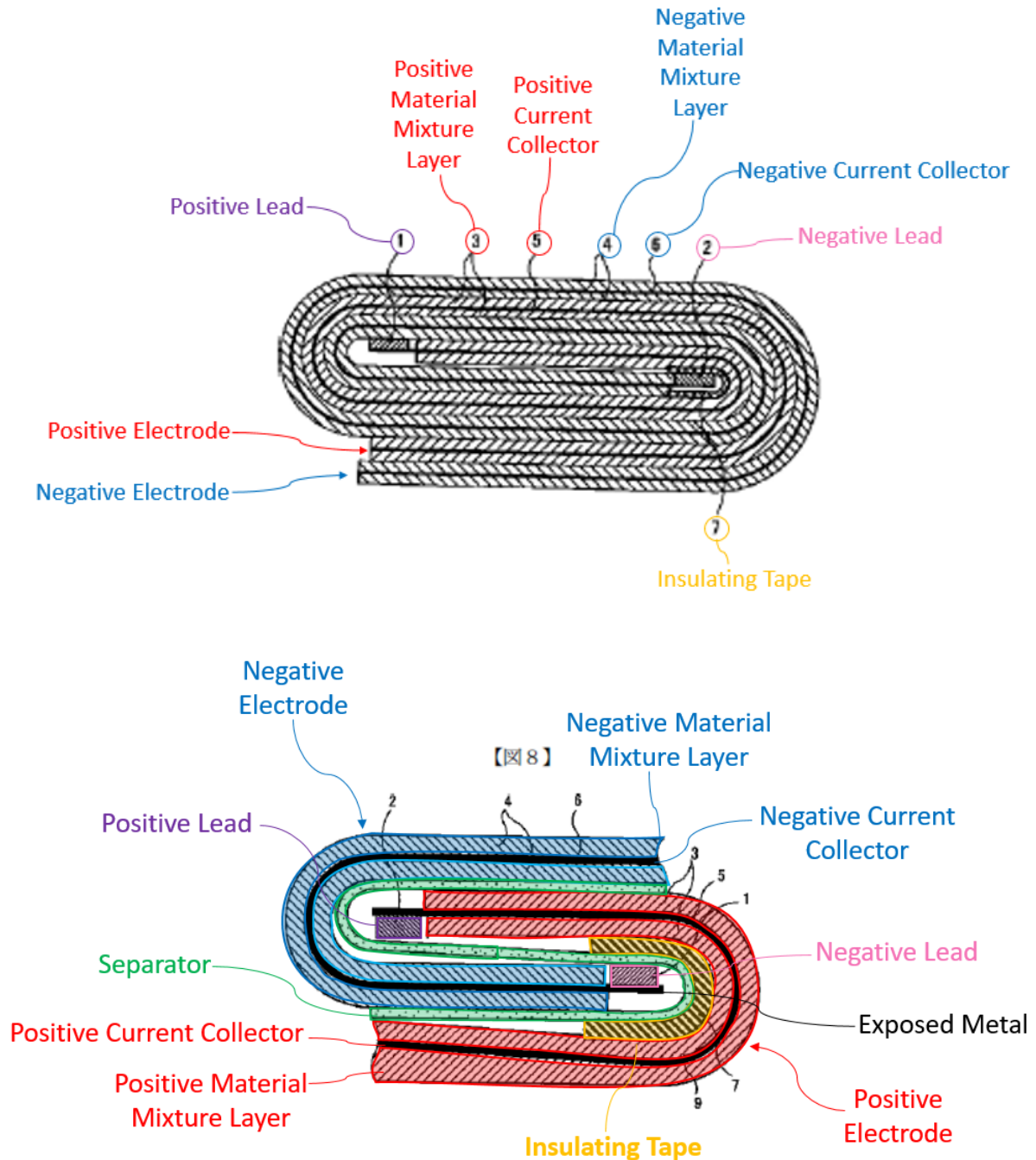


EX1006, FIG. 4 (annotated).

105. In the battery embodiment shown in Figures 8 and 9, reproduced below, 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 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 Figures 8 and 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 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.

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."



EX1006, FIGs. 8 and 9 (annotated).

C. Japanese Patent Pub. No. 2004-303950 to Kodama *et al.* (Kodama)

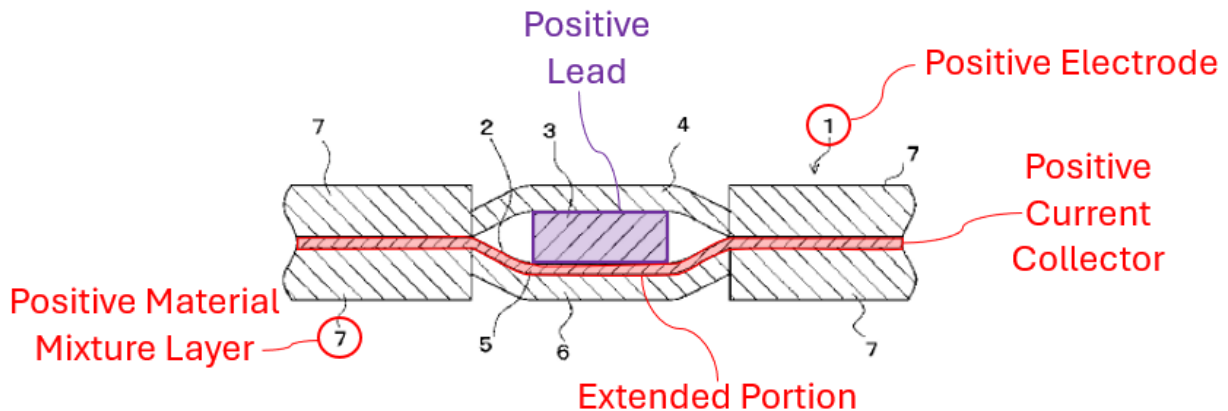
106. Japanese Patent Pub. No. 2004-303950 to Kodama *et al.* published on October 28, 2004. Kodama's publication date precedes the '330 patent's earliest

effective filing date of January 17, 2014, by almost 10 years.

107. Kodama discloses a lithium-ion battery similar to those described in Sato and the '330 Patent. EX1007, ¶¶[0001]-[0004], [0024]. Kodama's lithium-ion battery includes a positive electrode 1 formed by a positive electrode current collector 5 covered with a positive electrode active material 7. EX1007, ¶¶[0017], [0024]-[0026], FIG. 3. Kodama's lithium-ion battery also includes a negative electrode 21 formed by a negative electrode current collector 24 covered with a negative electrode active material. EX1007, ¶¶[0017], [0024], [0027], FIG. 3.

108. Kodama's positive electrode 1 "has uncoated portions 2 of the positive electrode mixture 7 on both sides near the center of the longitudinal direction of the positive electrode 1." EX1007, ¶[0026]. Kodama's "positive electrode tab 3 is welded to these uncoated portions 2." EX1007, ¶[0026]. Kodama teaches that, after winding and pressing, uncoated portion 2 of positive electrode 1 extends in a direction opposite the surface attached to tab 3 to provide "a space equal to the thickness of both sides of the mixture" for the tab connection, as shown below in Figure 3. EX1007, ¶[0028]. In this manner, the thicker positive lead 3 does not protrude above (or below) Kodama's positive active material layer 7. EX1007, ¶¶[0018], [0028]. Kodama teaches that such configuration is helpful to flatten its electrodes, which may prevent air bubbles from forming in Kodama's battery during electrolyte injection and, thereby, increase the capacity of Kodama's

battery.⁴ EX1007, ¶¶[0014]-[0016], [0018], [0028].



EX1007, FIG. 3 (annotated).

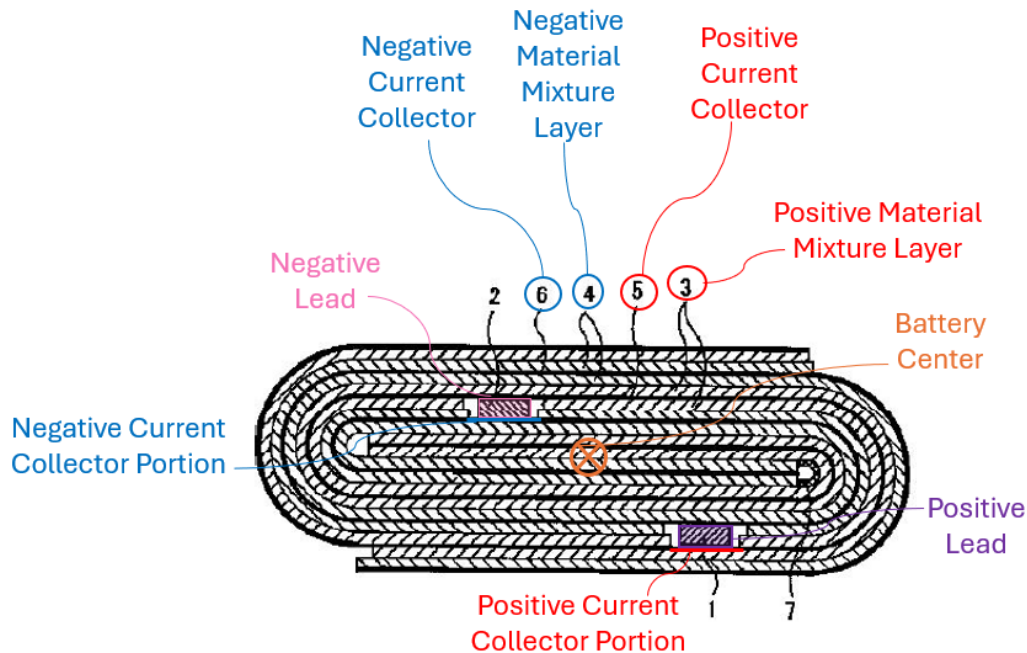
D. A POSA would have been motivated to combine Takemura with Sato and Kodama with a reasonable expectation of success.

109. Sato, Takemura, and Kodama are analogous art with respect to the '330 patent, as they all disclose lithium-ion batteries. EX1001, Abstract; EX1005, ¶[0001]; EX1006, ¶[0001]; EX1007, ¶[0001]. Similar to Sato, Kodama, and the '330 patent, Takemura's battery shown in Figure 4 includes a recess formed in a middle portion of the positive electrode to accommodate a positive lead 1 and a recess in a middle portion of the negative electrode to accommodate a negative lead 2. EX1006, ¶[0022], FIG. 4. As shown in Figure 4, reproduced below,

⁴ Although Kodama discusses the above-described configuration in the context of a positive electrode, a POSA would have understood that the same principles and benefits apply to recesses formed in a negative electrode as well.

Takemura further teaches a specific orientation of those leads relative to the battery center: the negative lead is disposed on a surface of the negative current collector facing away from the center of the battery, while the positive lead is disposed on a surface of the positive current collector facing toward the center of the battery.

EX1006, FIG. 4.



EX1006, FIG. 4 (annotated).

110. Although Sato discloses recessed positive and negative leads attached to the respective current collectors, Sato does not specify which surface of each current collector the lead is attached to relative to the center of the battery. In Sato, as would have been readily understood by a POSA, there are only a finite number of predictable options for attaching a lead to a current collector: (1) to the current collector surface facing toward the battery's center, or (2) to the current collector

surface facing away from the battery's center. Where, as here, the prior art provides a limited set of known alternatives and teaches the suitability of one of those alternatives for the same application, selecting that alternative is a matter of routine design choice well within the level of ordinary skill. EX1006, FIGs. 1, 3-5 (showing the positive and negative lead tabs oriented in different directions); EX1038, FIG. 3 (showing a negative lead 36 disposed on a surface of the negative current collector 320 facing away from the center of the battery and a positive lead 35 disposed on a surface of the positive current collector 310 facing toward the center of the battery).

111. The '330 patent claims one particular combination of tab orientations, namely where "the negative lead is disposed on the surface of the negative current collector facing away from the center" and where "the positive lead is disposed on the surface of the positive current collector facing a center of the battery." To the extent that Sato does not disclose or render obvious this limitation, a POSA would have found it obvious in view of the disclosures and teachings of the prior art, a POSA's background knowledge and experience, and common sense. For example, Takemura discloses a negative lead facing away from the center and a positive lead facing toward the center of the battery. EX1006, FIG. 4. A POSA would have been motivated to connect Sato's lead tabs to recessed electrodes according to a known lead tab orientation, such as the lead orientation explicitly disclosed in FIG. 4 of

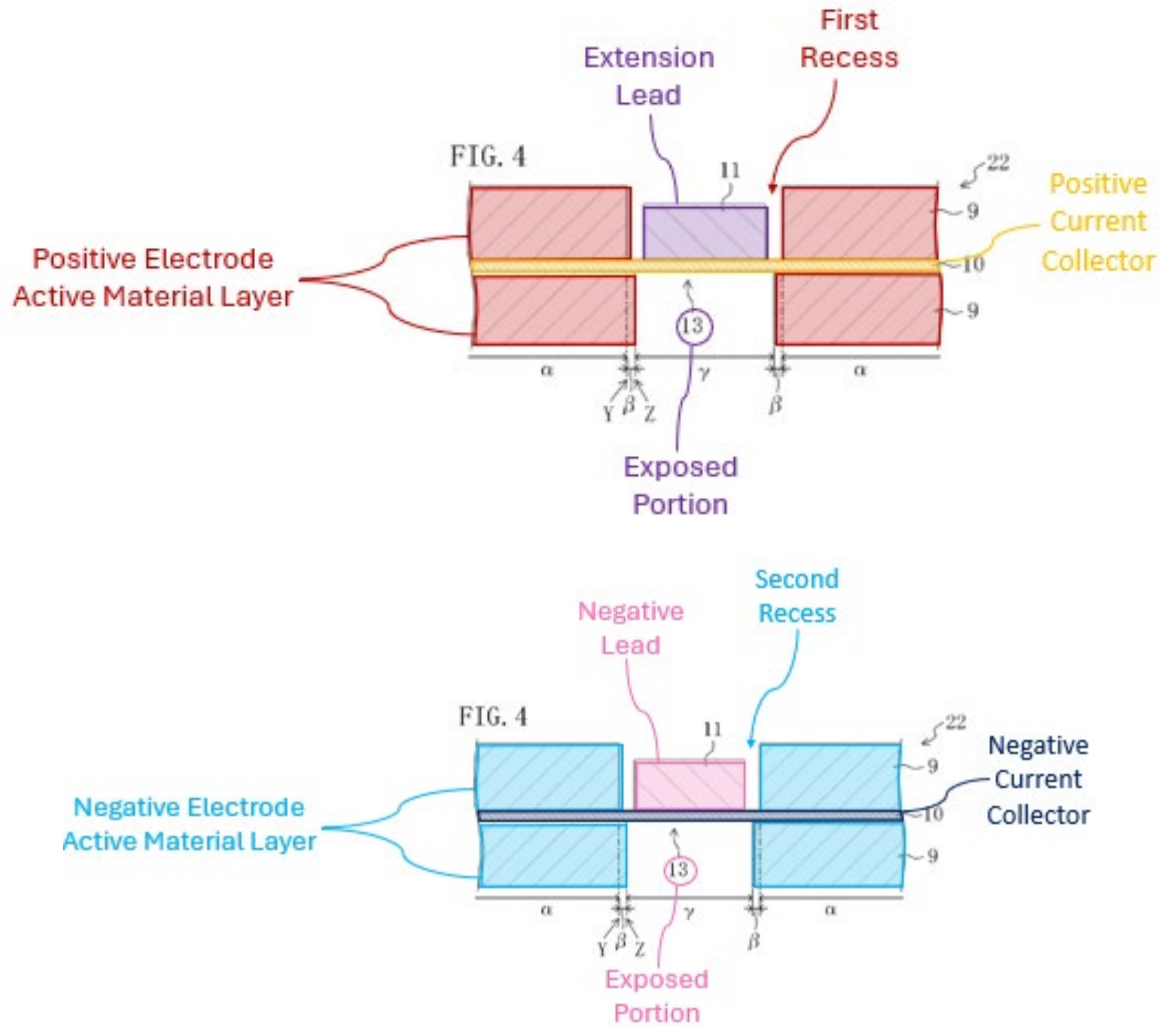
Takemura, to provide a lead tab connection that is fully compatible with recessed electrodes in lithium-ion batteries. EX1006, ¶¶[0022]–[0024]. A POSA would have understood that orienting the lead tabs as shown in Figure 4 of Takemura—negative tab facing away from the battery’s center and positive tab facing toward the battery’s center—would not meaningfully affect the Sato’s battery cell performance, reliability, and safety. Thus, this modification would have simply been applying a known technique (orienting the negative tab to face away from the battery’s center and the positive tab to face toward the battery’s center) to a known device (Sato’s battery) to provide the predictable result of placing the tabs in a known and conventional orientation for an electrode assembly.

112. A POSA would have also had a reasonable expectation of success adopting the particular lead orientation shown in Takemura’s Fig 4 because the leads need to be attached to the current collector for Sato’s battery to function, and the choice of lead orientation has no impact on battery performance, reliability or safety. A POSA would have understood that Takemura’s lead orientation could be directly applied to Sato’s design while maintaining the staggered active material edges located on opposite sides of the exposed portion of Sato’s current collector. Takemura affirmatively demonstrates that the claimed orientation operates successfully in a comparable battery configuration. Thus, a POSA would have reasonably expected that adopting one of Takemura’s lead-orientations in Sato

would function as intended and yield a predictable, operable battery assembly.

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

113. Sato, Takemura, and Kodama are analogous art with respect to the '330 patent, as they all disclose lithium-ion batteries. EX1001, Abstract; EX1005, ¶[0001]; EX1006, ¶[0001]; EX1007, ¶[0001]. Sato, Takemura, and Kodama each disclose a recess—i.e., an exposed portion of a current collector without active material—formed in a middle portion of an electrode to receive a lead tab. EX1005, ¶¶[0036], [0038]-[0041], FIG. 4; EX1006, ¶[0022], FIG. 4; EX1007, ¶¶[0018], [0028]. Sato recognizes concerns about stress concentrations at the lead connections in the middle portion of the electrode due to abrupt thickness changes between the active material layers and the exposed current collector. EX1005, ¶[0024]. To minimize this transition, Sato staggers the edges of the active material layers located on opposite sides of the current collector, as shown below in Figure 4. EX1005, ¶[0040].

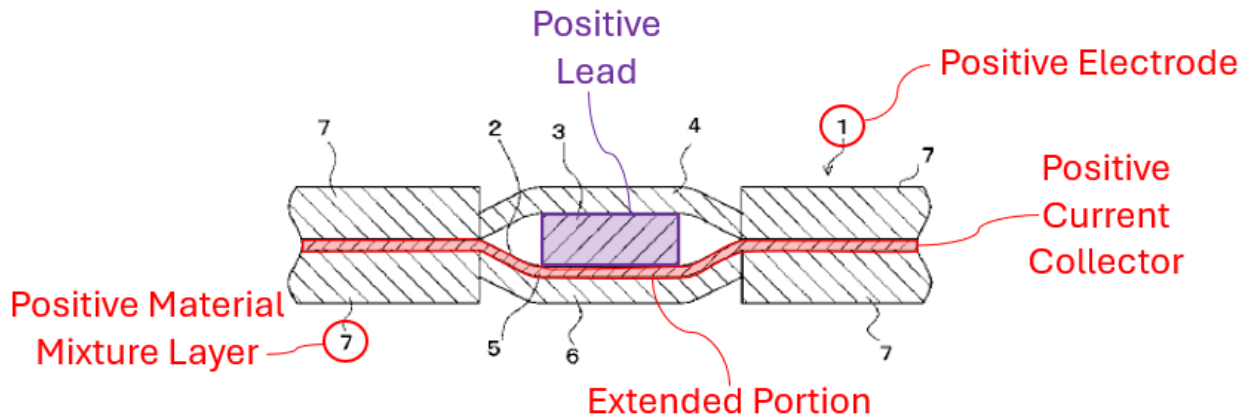


EX1005, FIG. 4 (annotated).

114. However, Sato does not expressly disclose extending the exposed portion of the current collector in a direction opposite the lead tab-attachment surface. Absent such an extension, the thickness of the lead tab must be minimized to prevent the tab from protruding above the active material layer, which in turn limits the available cross-sectional area for current flow from the electrode to the battery's terminal. EX1036, ¶[0077]; EX1035, ¶¶[0026]-[0027]. Conversely, increasing the lead tab's thickness to improve current flow would cause the tab to

protrude above the active material layer, creating localized discontinuities that concentrate stress during winding and flattening operations that can damage the separator. EX1007, ¶[0014]; *cf.* EX1007, [0017]-[0018]; EX1037, ¶[0008]. Thus, a POSA would have recognized the benefit of a lead-attachment configuration that accommodates a thicker lead tab while minimizing discontinuities in the electrode profile.

115. Kodama provided a known way to secure a thicker lead tab in a centrally-located recess of an electrode while minimizing discontinuities along the electrode's profile. *See* Section, VII.B. As shown below in Figure 3, Kodama's electrode 1 includes a recess—a non-coated portion 2 of current collector 5 — connected to lead tab 3. EX1007, ¶¶[0024]-[0026]. The current collector's non-coated portion 2 extends in a direction opposite the current collector surface attached to lead tab 3, allowing lead tab 3 to have a thickness that is approximately equal to the overall thickness of electrode 1 without protruding above the active material layer 7. EX1007, ¶¶[0015], [0018], [0028]. By accommodating a thicker lead tab within an indented recess of the current collector, Kodama reduces electrical resistance while avoiding abrupt thickness changes along the electrode's surface.



EX1007, FIG. 3 (annotated).

116. A POSA would have also understood that using a thicker lead tab would prolong operability of the battery by being more mechanically robust. EX1035, ¶[0026]. In particular, a thicker lead tab necessarily provides increased cross-sectional area, which not only reduces electrical resistance and associated joule heating, but also improves the tab's ability to withstand repeated mechanical loading during manufacturing and use. As recognized in the art, lead tabs are subject to significant stresses—e.g., during winding, flattening, and handling—and are a critical failure point because they provide the only electrical connection between the electrode assembly and the external terminal. EX1037, ¶[0008]. A thicker tab is less susceptible to deformation, fatigue, and fracture under such conditions, and correspondingly reduces the risk of tab breakage or detachment over the battery's service life. EX1035, ¶[0026].

117. In view of Kodama, a POSA would have recognized that extending Sato's exposed current-collector portion in a direction opposite the lead tab-

attachment surface would allow Sato's electrode to employ a thicker lead tab while avoiding the known disadvantages associated with tab protrusion above the active material layer. Specifically, this deflection of Sato's lead tab-attachment surface would have prevented localized profile discontinuities, reduced mechanical stress during winding and flattening, and protected the separator from concentrated loading. EX1007, ¶¶[0017]-[0018], [0028].

118. Although Kodama expressly describes this configuration in the context of a positive electrode, a POSA would have readily understood that the same principles and advantages apply to recesses formed in the middle portion of negative electrodes as well. EX1007, ¶¶[0014]-[0015]. Locating tabs in the middle portion of electrodes induces stress concentrations, regardless of the electrode's polarity. Because negative electrodes in lithium-ion batteries are constructed with the same basic layered structure (current collector with active material coatings) and are subject to the same manufacturing processes (e.g., winding and flattening), a POSA would have understood that Kodama's technique would function in an analogous manner if applied to a negative electrode with a centrally-located lead tab. Thus, the applicability of Kodama's tab connection technique does not depend on electrode polarity.

119. In the context of Sato's negative electrode—the negative lead tab is located in a middle portion of the negative electrode—a POSA would have

understood to extend the exposed portion of Sato's negative current collector in a direction opposite the lead tab-attachment surface, forming the same recessed configuration taught by Kodama. Accordingly, a POSA would have understood to extend the exposed portion of Sato's negative current collector toward the battery center when the negative lead tab is facing away from the battery center. A POSA would have also understood to extend the exposed portion of Sato's positive current collector away from the battery center when the positive lead tab is facing the battery center. A POSA therefore would have been motivated to combine the teachings of Kodama's recessed lead-tab configuration with Sato's electrodes to accommodate a thicker lead tab while maintaining a smooth electrode profile, thereby improving electrical performance, mechanical robustness, manufacturability, and reliability.

120. A POSA would have had a reasonable expectation of success in combining Kodama's teachings with Sato because this modification would not alter the fundamental electrochemical operation of Sato's battery. The same electrode materials, current collectors, separator, and electrolyte would be used, and the current collector would continue to perform its conventional current-collection function. Thus, this modification represents the application of a known technique (extending the non-coated portion of the current collector in a direction opposite the lead tab-attachment surface) to accommodate a thicker tab in

a known device (Sato's battery) to make it more robust and reduce resistance without producing discontinuities in the electrode's profile. This modification would have been a simple substitution of one known element (an indented current collector) for another (flat current collector) to reduce internal current resistance while maintaining a smooth electrode profile.

121. Furthermore, a POSA would have understood how to maintain the active material layers' staggered edges on Sato's current collector while extending the current collector's exposed portion in a direction opposite the lead tab-attachment surface. As shown in Figures 4 and 5, Sato recognizes that the width of the active material layer located on the surface of the current collector opposite to the lead tab may differ, provided that "the width of the no-mixture-layer portion on the surface connected to the lead is preferably larger than that of the no-mixture-layer portion on the surface opposite the surface connected to the lead." EX1005, ¶[0043]. Thus, it would have been well within the level of ordinary skill in the art to make the active material layer opposite the lead tab wider than the active material layer adjacent to the lead tab, while still extending the exposed portion of Sato's current collector in a direction opposite the lead tab-attachment surface to preserve the staggered active material edge arrangement.

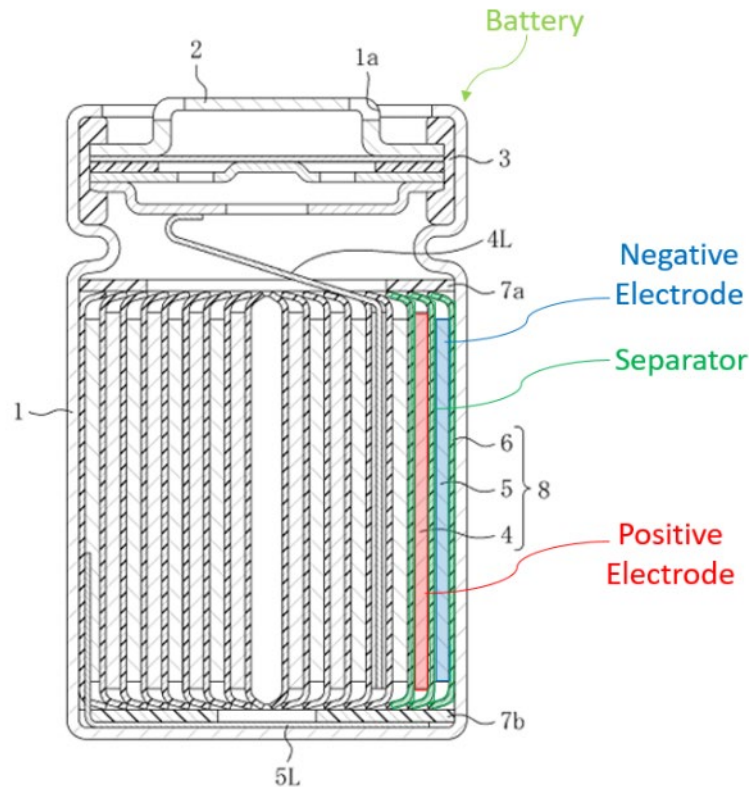
F. Independent Claims 1 and 11

1. [1.P]/[11.P] A lithium-ion battery, comprising:

122. 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 $\frac{1}{4}$ to $\frac{3}{4}$ 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 (EX1026), 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. 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.

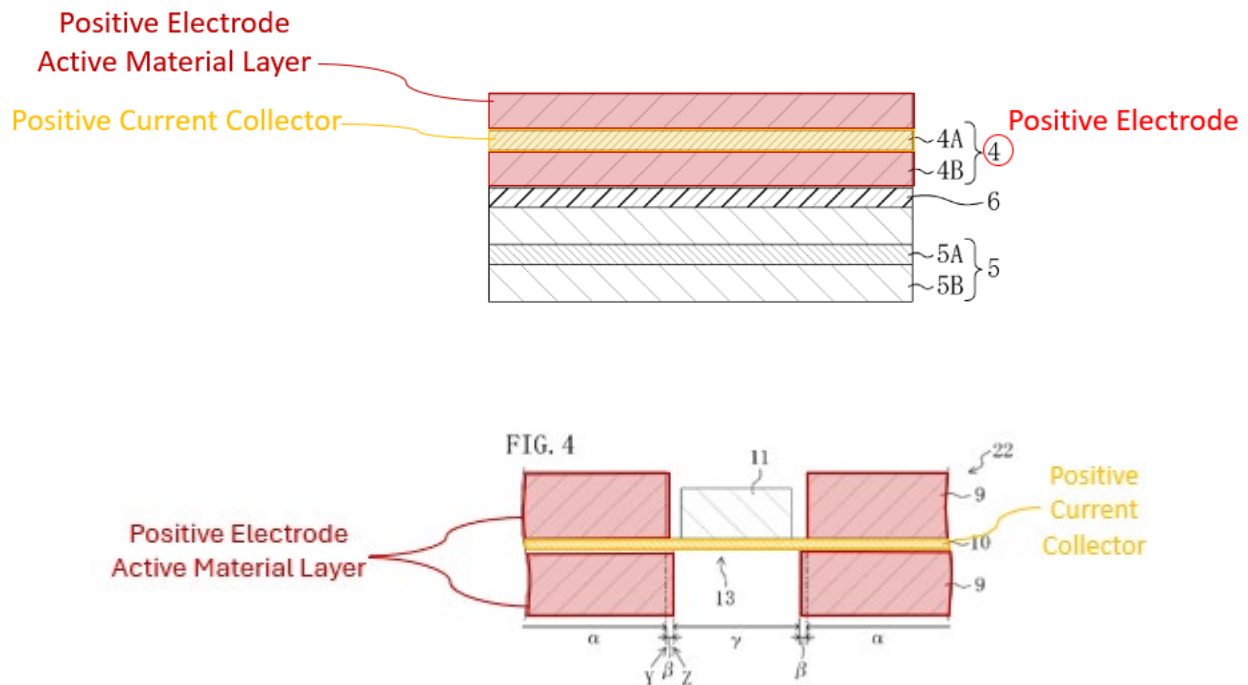


EX1005, FIG. 1 (annotated).

2. **[1.A]/[11.A] a positive electrode comprising a positive current collector and a positive electrode active material layer [containing lithium cobalt oxide, wherein the positive electrode active material layer is / being] formed on the positive current collector, and**

123. 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], [0033] and [0036]-[0041], FIGs. 2, 4. 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, 4 (annotated).

124. 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], [0033]-[0041]. 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].

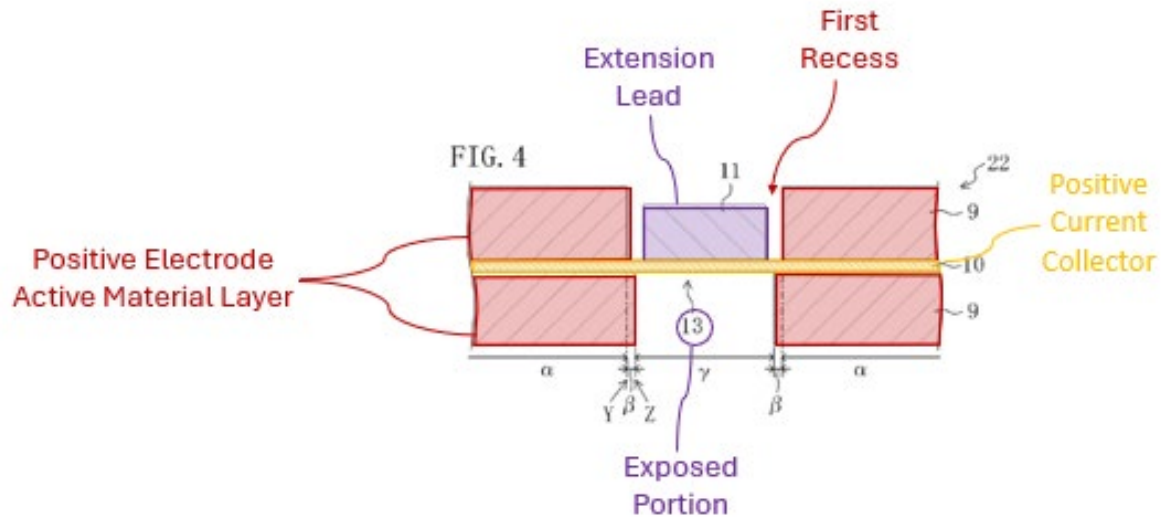
125. As illustrated in Figure 2, for example, and explained by Sato, “the positive electrode plate 4 includes a positive electrode current collector 4A and a positive electrode material mixture layer 4B.” EX1005, ¶[0033]. Sato’s positive electrode current collector 4A “is in the shape of a band, and 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, ¶[0051], *see also* ¶¶ [0104], [0136]. 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.

126. Accordingly, a POSA would have understood that Sato discloses Elements [1.A]/[11.A].

3. **[1.B]/[11.B] [wherein] the positive electrode active material layer is provided with a first recess accommodating a positive lead being coupled with the positive current collector;**

127. Sato discloses that the positive active material layer (4B/9) is provided with a first recess (exposed portion 13) accommodating a positive lead (lead 11)

coupled with the positive current collector (4A/10). EX1005, ¶¶[0036]-[0041], [0094], [0111]-[0113], FIGs. 2, 4.⁵ Both sides of Sato's positive current collector (4A/10) are coated with the positive active material layer (4B/9). EX1005, ¶¶[0036]-[0041], [0093]-[0094], [0111]-[0113], FIGs. 2, 4.



EX1005, FIG. 4 (annotated).

128. 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

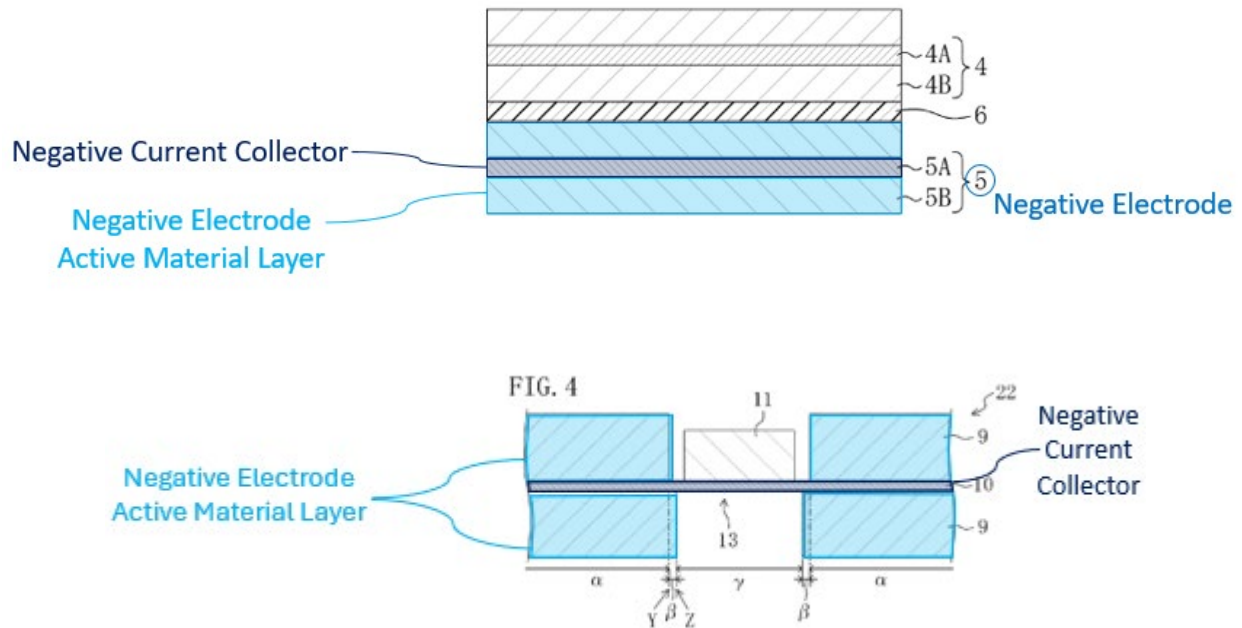
⁵ A POSA would have understood that Sato's extension lead 11 shown in Figure 4 is representative of a positive lead and a negative lead. EX1005, ¶93 ("A lead is connected in order to take current and Voltage from the positive electrode plate 4 and the negative electrode plate 5. In this connection, a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

current collector (4A/10) to create the exposed portion 13 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, ¶¶[0036]-[0041], [0111]-[0113].

129. Accordingly, a POSA would have understood that Sato discloses Elements [1.B]/[11.B].

4. **[1.C]/[11.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 / being] formed on the negative current collector,**

130. 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], [0036]-[0041], FIGs. 2, 4; 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] (“[N]egative electrode active material include[s]...a carbon material [and]...silicon compound.”).



EX1005, FIGs. 2, 4 (annotated).

131. 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], [0033]-[0041]. 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].

132. 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

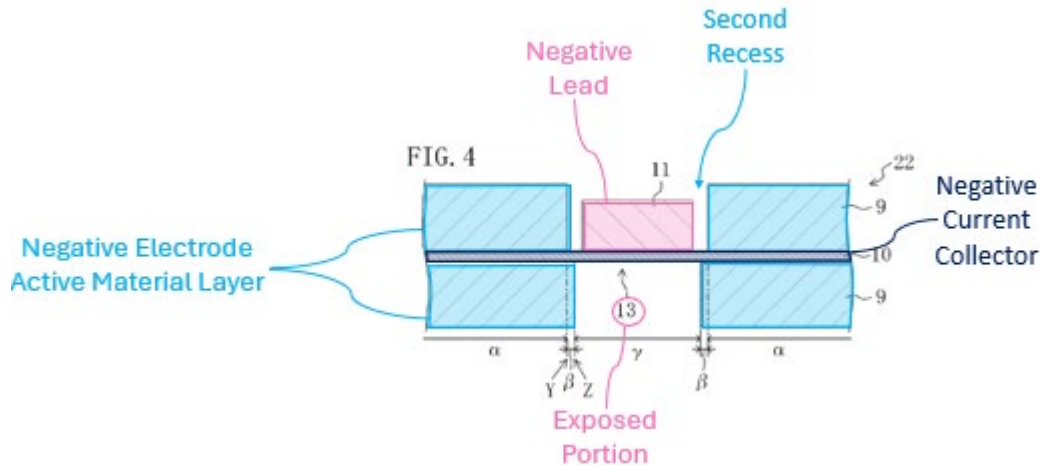
material mixture layer 5B is “provided on each surface of the negative electrode current collector 5A, and contains a negative electrode active material.” EX1005, ¶[0034]. Sato’s negative electrode material mixture layer 5B is formed from a “metal, metal fiber, a carbon material, oxide, nitride, a silicon 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 5B is a common negative electrode active material that allows for efficient lithium ion intercalation and deintercalation during charging and discharging. EX1023, 199.

133. Accordingly, a POSA would have understood that Sato discloses elements [1.C]/[11.C].

5. [1.D][11.D] [wherein] the negative electrode active material layer [is / being] provided with a second recess accommodating a negative lead being coupled with the negative current collector; and

134. Sato discloses that the negative electrode active material layer (5B/9) is provided with a second recess (exposed portion 13) accommodating a negative lead (lead 11) coupled with the negative current collector (5A/10). EX1005, ¶¶[0039], [0041], [0093]-[0094], [0136], [0137], FIG. 4. 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. 2, 4.



EX1005, FIG. 4 (annotated).

135. In particular, Sato describes making the battery cell by peeling away the negative active material layer (5B/9) from the surface of the negative electrode current collector to create the exposed portion 13 in the form of a recess in the negative active material layer (5B/9), and attaching the negative lead 11 within the recess. EX1005, ¶¶[0111]-[0113], and [0136]-[0137].

136. Should Patent Owner contend that Sato does not disclose a specific battery embodiment having a first recess in the positive electrode and a second recess in the negative electrode, Sato expressly states the lead attachment position “is preferably located in the region from 1/4 to 3/4” of the electrode and “at least one of the positive electrode and the negative electrode satisfies [these] conditions for the lead attachment position.” EX1005, ¶[0094]. A POSA would have

understood that the “at least one of the positive electrode and the negative electrode” description in paragraph [0094] of Sato includes an embodiment, in which both the positive and negative electrodes each have a recess for accommodating a lead. This understanding is consistent with Sato’s summary, detailed description, and claims, and would have been clear to a POSA. EX1005, ¶¶[0010]-[0013] (describing that “**at least one** of the positive electrode plate and the negative electrode plate is the electrode plate” having an “exposed portion” on the “current collector”), [0036] (describing that “[i]n a portion of **at least one** of the positive electrode plate 4 and the negative electrode plate 5 to which the lead is connected, the mixture layer is not formed on one surface of the current collector connected to the lead”), claim 6 (reciting “**at least one** of the positive electrode plate and the negative electrode plate is the electrode plate of claim 1,” which includes a recess for lead connection). Thus, Sato discloses both a “first recess” in the positive electrode and a “second recess” in the negative electrode.

137. Accordingly, a POSA would have understood that Sato discloses Elements [1.D]/[11.D].

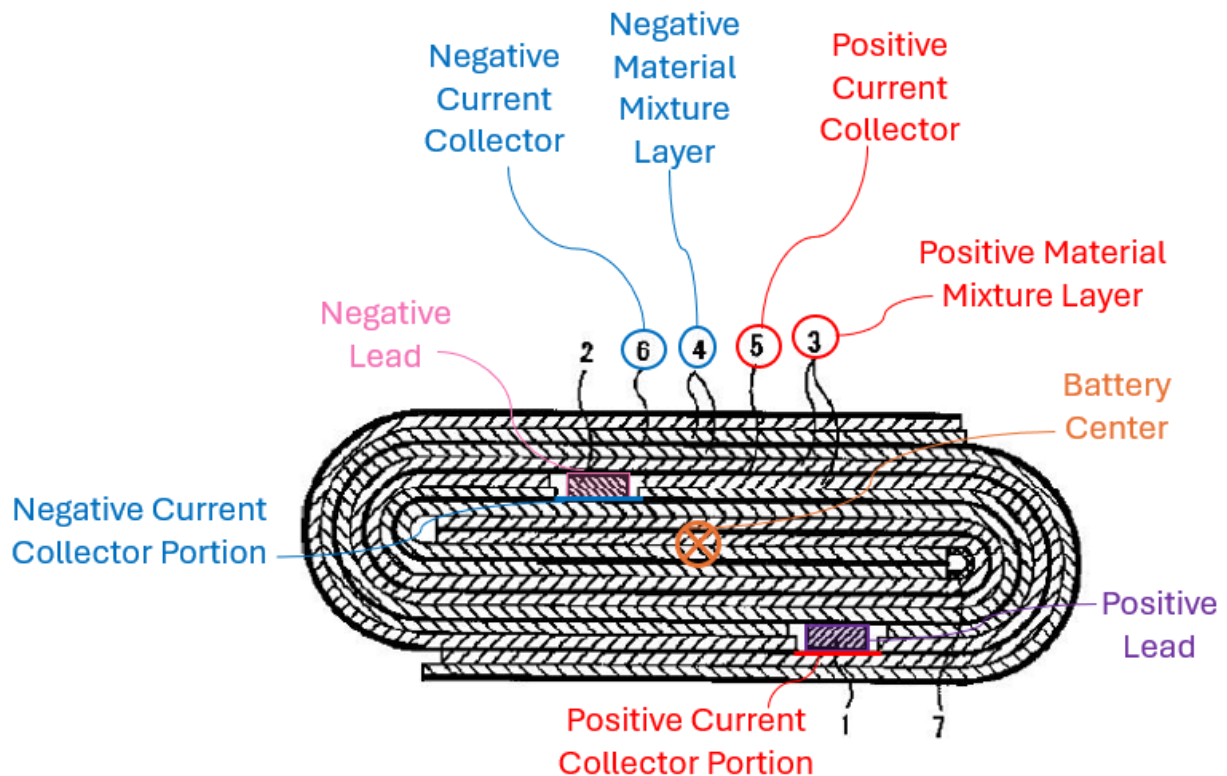
6. [1.E][11.E] the negative lead is disposed on a surface of the negative current collector facing away from the center of the battery; and
 - a. Sato

138. Sato is silent about which surface of the negative current collector is

attached to the negative lead relative to the direction of the battery's center.

b. Takemura

139. Takemura discloses a battery including a negative lead (2) disposed on a surface of a negative current collector (6) that faces away from a center of the battery. EX1006, ¶[0022], FIG. 4.



EX1006, FIG. 4 (annotated).

140. Specifically, Takemura describes and illustrates the negative lead (2) disposed on the surface of the negative current collector (6) that faces away from a center of the battery, as well as a positive lead (1) disposed on a surface of a positive current collector (5) that faces the center of the battery. EX1006, ¶[0022],

FIG. 4. A POSA would have understood that Takemura's configuration is one of two straightforward, conventional options for attaching a lead tab to a current collector. That is, attaching the lead tab to (i) a surface of the current collector that faces toward a battery's center or (ii) a surface of the current collector that faces away from the battery's center.

c. Sato-Takemura Combination

141. In view of Sato's and Takemura's disclosures, it would have been obvious for a POSA to modify Sato to have its negative lead (11) disposed on a surface of Sato's negative current collector (10) that faces away from a center of Sato's battery, similar to the configuration taught in Takemura. Indeed, such a modification would have involved a simple choice of one of two finite, predictable solutions (i.e., disposing the negative lead (11) on a center-facing surface of the current collector (10)) or the other (i.e., disposing the negative lead (11) on an outward-facing surface of the current collector (10)).

142. A POSA would have had a reasonable expectation of success in modifying Sato to have its negative lead (11) disposed on a surface of Sato's negative current collector (10) that faces away from a center of Sato's battery, at least because such modification would not affect the fundamental electrochemical operation of Sato's battery. For example, negative lead (11) would remain operative to "take current and voltage from . . . the negative electrode plate 5."

EX1005, ¶[0093].

143. Accordingly, a POSA would have understood that the combined disclosures of Sato and Takemura render Elements [1.E]/[11.E] obvious.

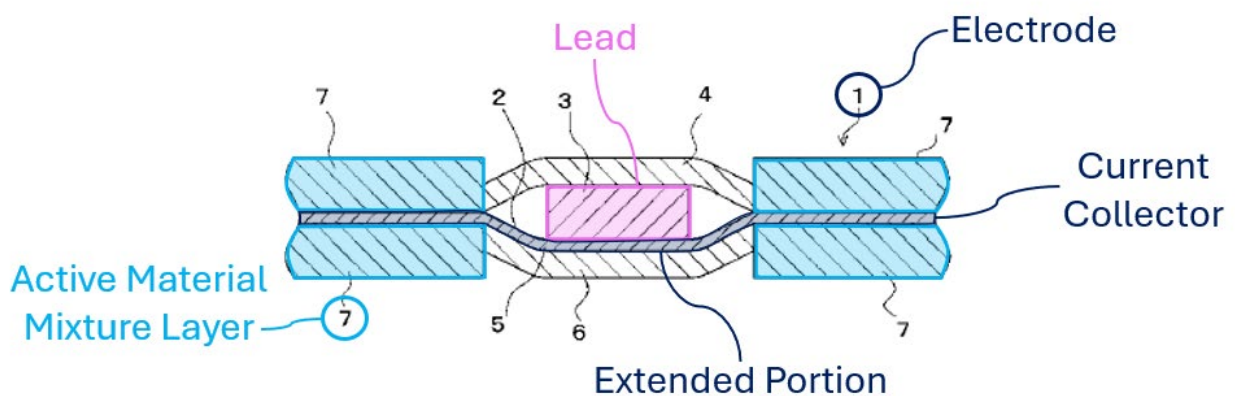
7. **[1.F][11.F] a portion of the negative current collector where the negative lead is disposed extends towards the center of the battery;**

a. Sato-Takemura

144. Sato, as modified by Takemura, does not expressly disclose extending the exposed portion of the negative current collector toward the battery center.

b. Kodama

145. Kodama discloses a non-coated portion (2) of a current collector (5), where a lead tab (3) is disposed, extending in a direction opposite to the current collector surface attached to lead tab (3). EX1007, ¶¶[0018], [0028], FIG. 3.



EX1007, FIG. 3 (annotated).

146. In particular, Kodama describes extending non-coated portion (2) of

the current collector (5), where the lead (3) is disposed, in a direction opposite the lead tab-attachment surface to accommodate a thicker lead (3). EX1007, ¶¶[0018], [0028]. Kodama's disclosure (e.g., paragraphs [0018] and [0028]) reflect that the current collector portion at the tab location is effectively indented or deflected relative to the surrounding active material layer to create "a space equal to the thickness of the mixture on both sides" of the current collector to receive the lead tab. In this manner, the thicker lead (3) does not protrude above (or below) Kodama's active material layer (7). EX1007, ¶¶[0018], [0028]. Kodama teaches that such configuration is helpful to flatten its electrodes, which may prevent air bubbles from forming in Kodama's battery during electrolyte injection and, thereby, increase the capacity of Kodama's battery. EX1007, ¶¶[0014]-[0016], [0018], [0028]. Because Kodama discloses extending the non-coated portion 2 in a direction opposite the surface to which the lead tab is attached, a POSA would have understood that, when the negative lead is disposed on a surface of the current collector facing away from the battery center, the non-coated portion extends toward the battery center.

147. Although Kodama expressly describes this configuration in the context of a positive electrode, a POSA would have readily understood that the same principles and advantages apply to recesses formed in the middle portion of negative electrodes as well. For the reasons discussed in Section IX.E, locating

tabs in the middle portion of electrodes induces stress concentrations, regardless of the electrode's polarity. Given the structural similarities between negative and positive electrodes with centrally-located recesses, as disclosed in Sato, a POSA would have understood Kodama's technique would function in an analogous manner if applied to a negative electrode with a centrally-located lead tab.

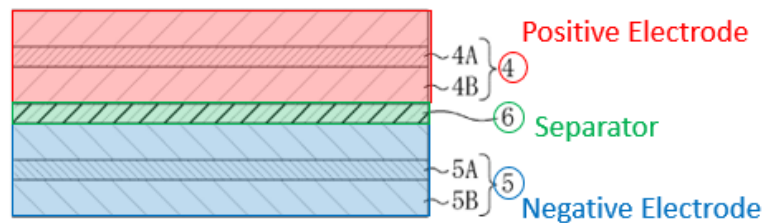
c. Sato-Kodama-Takemura Combination

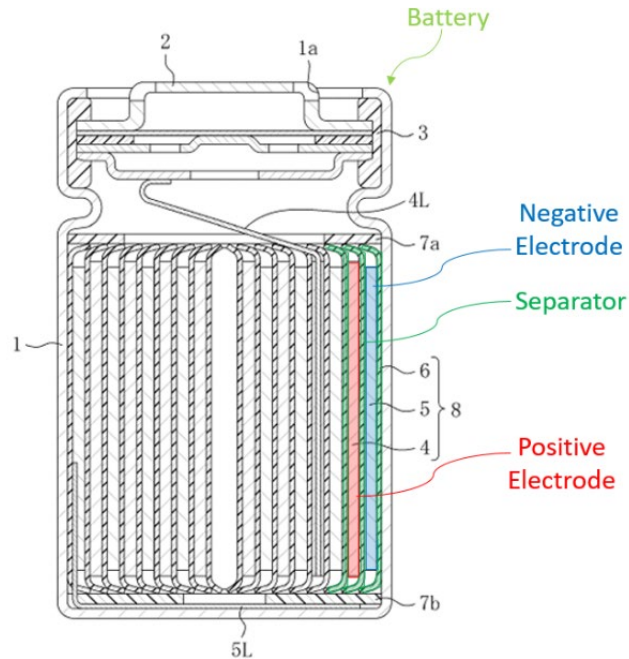
148. In view of Sato's, Kodama's, and Takemura's disclosures, it would have been obvious to a POSA to extend the exposed portion of Sato's negative current collector, as modified by Takemura, toward the center of the battery. Such modification, as taught by Kodama, would accommodate a lead tab having a thickness approximately equal to the overall thickness of the electrode without protruding above the active material layer. EX1007, ¶¶[0015], [0018], [0028]. Accommodating a thicker lead tab within the indented recess of Sato's modified current collector would reduce electrical resistance while avoiding abrupt thickness changes along the electrode's surface. EX1007, ¶¶[0015], [0018], [0028]. Modifying Sato's negative current collector, as modified by Takemura, would have simply been the application of a known technique (extending a non-coated portion of a current collector in a direction opposite the lead tab-attachment surface) to a known device (Sato's battery as modified by Takemura) to achieve the predictable result of improving the battery's storage capacity.

149. Accordingly, a POSA would have understood that the combined disclosures of Sato, Kodama, and Takemura render Elements [1.F]/[11.F] obvious.

8. [1.G][11.G] a separator disposed between the positive electrode and the negative electrode; and

150. 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. “[T]he 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, FIGs. 1, 2 (annotated).

151. Accordingly, a POSA would have understood that Sato discloses Elements [1.G]/[11.G].

9. [1.H]/[11.H] an electrolyte.

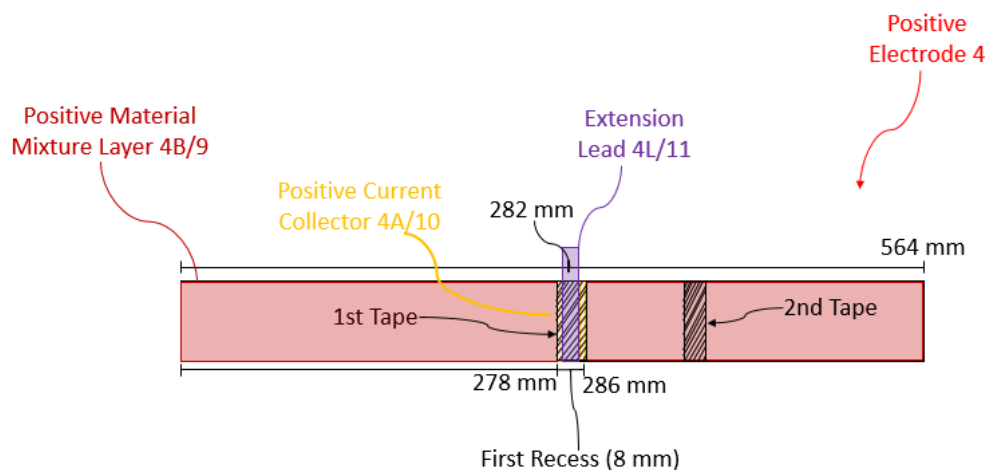
152. Sato discloses an electrolyte, for example, a liquid nonaqueous electrolyte, a gelled nonaqueous electrolyte, or a solid nonaqueous electrolyte. EX1005, ¶¶[0028], [0044], and [0074]; *see also* EX1006, ¶[0003]; (disclosing a non-aqueous electrolyte).

153. Accordingly, a POSA would have understood that Sato discloses Elements [1.H]/[11.H].

- G. Claims 2/12 “wherein a distance between a center of the first recess and one end of the positive electrode active material layer is $\frac{1}{4}$ - $\frac{3}{4}$ 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 $\frac{1}{4}$ - $\frac{3}{4}$ of a length of the negative electrode active material layer.”**

154. Sato discloses that a distance between a center of the first recess (exposed portion 13 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 $\frac{1}{4}$ - $\frac{3}{4}$ 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 13 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 $\frac{1}{4}$ - $\frac{3}{4}$ of a length of the negative electrode active material layer (layer 5B/9). EX1005, ¶[0137] According to Sato, the center of the exposed portion 13 is located at $\frac{1}{2}$ the length of the active layers in the electrodes of Sato’s Batteries 1 and 8 described in paragraphs [0111]-[0113], [0136], and [0137]. Furthermore, in view of Sato’s disclosure (EX1005, ¶¶[0010]-[0013], [0036], [0093]-[0094], [0136], and claim 6), a POSA would have understood that the recess dimensions of the positive electrode described in Battery 1 and the recess dimensions of the negative electrode described in Battery 8 would have been included in a battery embodiment having both a first recess in the positive electrode and a second recess in the negative electrode.

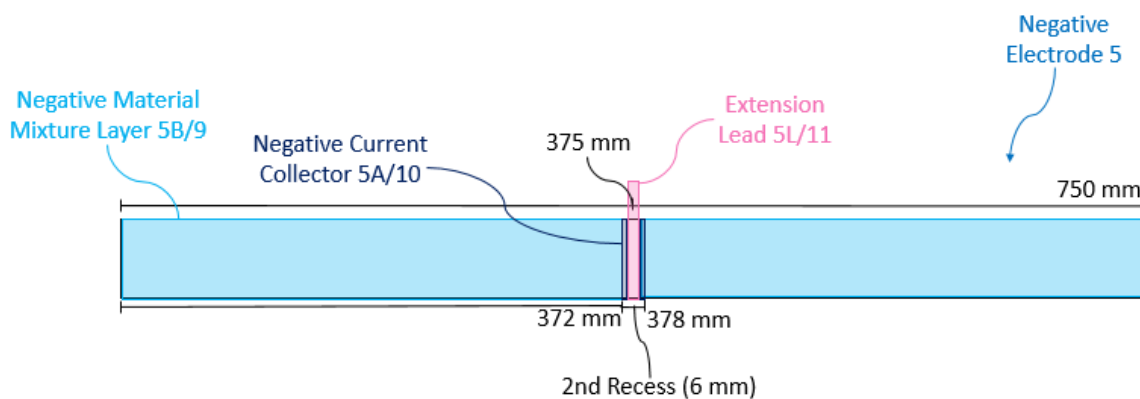
155. The dimensions of the positive and negative electrodes in Sato's Battery 1 and Battery 8 are illustrated in the following annotated figures. A POSA would have understood that the positive electrode active material layer begins at the ends of the electrode plate in view of Sato's positive electrode 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's Positive Electrode.

156. 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% ($\frac{282 \text{ mm}}{564 \text{ mm}}$) of the length of Sato’s positive electrode.



Sato’s Negative Electrode.

157. 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% ($\frac{375\text{ mm}}{750\text{ mm}}$) of the length of Sato's negative electrode.

158. Accordingly, a POSA would have understood that Sato discloses claims 2 and 12.

159. 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 $\frac{1}{4}$ to $\frac{3}{4}$ " 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 $\frac{1}{4}$ to $\frac{3}{4}$."). Accordingly, arranging the location of Sato's positive lead attachment to be within $\frac{1}{4}$ to $\frac{3}{4}$ of a length of the positive electrode active material layer and Sato's negative lead attachment to be within $\frac{1}{4}$ to $\frac{3}{4}$ of a length of the negative electrode active material

layer would have been obvious to promote efficient current collection.

H. Claims 3/13

1. [3.A]/[13.A] wherein, the positive lead is disposed on a surface of the positive current collector facing a center of the battery

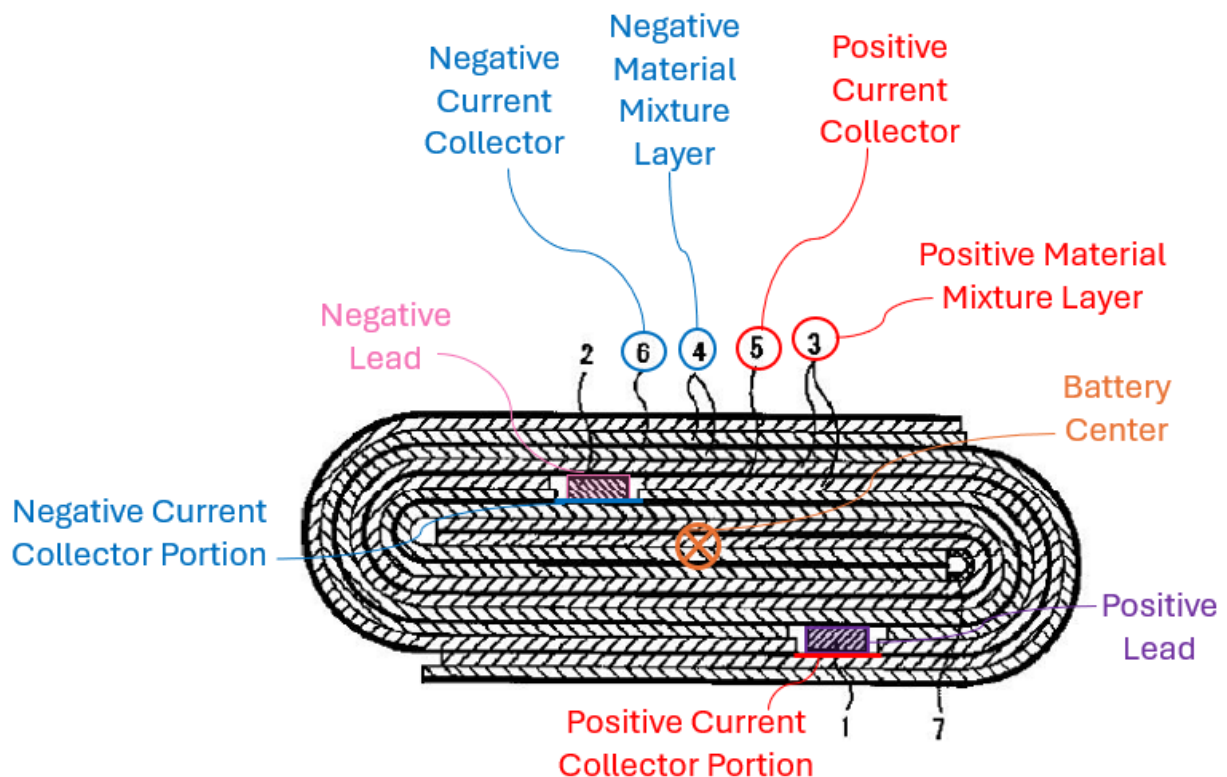
a. Sato

160. Sato is silent about which surface of the positive current collector is attached to the positive lead relative to the direction of the battery's center.

b. Takemura

161. Takemura discloses a battery including a positive lead (1) disposed on a surface of a positive current collector (5) that faces toward a center of the battery.

EX1006, ¶ [0022], FIG. 4.



EX1006, FIG. 4 (annotated).

162. Specifically, as noted above, Takemura describes and illustrates a negative lead (2) disposed on the surface of a negative current collector (6) that faces away from a center of the battery, as well as a positive lead (1) disposed on a surface of a positive current collector (5) that faces the center of the battery.

EX1006, ¶ [0022], FIG. 4. A POSA would have understood that Takemura's configuration is one of two straightforward, conventional options for attaching a lead tab to a current collector. That is, attaching the lead tab to (i) a surface of the current collector that faces toward a battery's center or (ii) a surface of the current collector that faces away from the battery's center.

c. Sato-Kodama-Takemura Combination

163. In view of Sato's, Kodama's, and Takemura's disclosures, it would have been obvious for a POSA to modify Sato to have its positive lead (11) disposed on a surface of Sato's positive current collector (10) that faces toward a center of Sato's battery, similar to the configuration taught in Takemura. Indeed, such a modification would have involved a simple choice of one of two finite, predictable solutions (i.e., disposing the positive lead (11) on an outward-facing surface of the current collector (10)) or the other (i.e., disposing the positive lead (11) on a center-facing surface of the current collector (10)).

164. A POSA would have had a reasonable expectation of success in

modifying Sato to have its positive lead (11) disposed on a surface of Sato's positive current collector (10) that faces toward a center of Sato's battery, at least because such modification would not affect the fundamental electrochemical operation of Sato's battery. For example, positive lead (11) would remain operative to "take current and voltage from the positive electrode plate 4." EX1005, ¶[0093].

165. Accordingly, a POSA would have understood that the combined disclosures of Sato, Kodama, and Takemura render Elements [3.A]/[13.A] obvious.

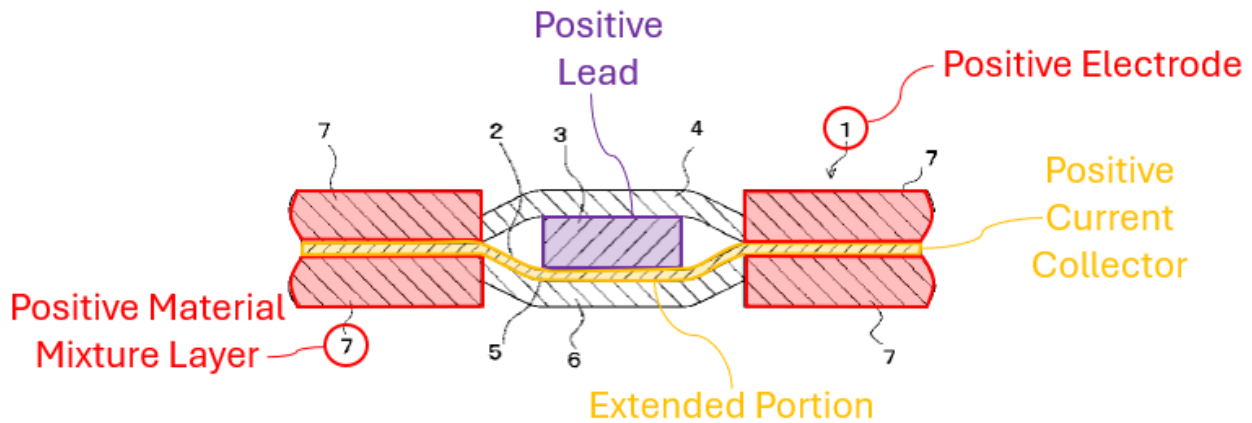
2. [3.B]/[13.B] a portion of the positive current collector where the positive lead is disposed extends away from the center of the battery.

a. Sato

166. Sato, as modified by Takemura, does not expressly disclose extending the exposed portion of the positive current collector away from the center of the battery.

b. Kodama

167. Kodama discloses a portion (2) of a positive current collector (5), wherein a positive lead (3) is disposed, extending in a direction opposite to the current collector surface attached to the positive lead (3). EX1007, ¶¶[0018], [0028], FIG. 3.



EX1007, FIG. 3 (annotated).

168. In particular, Kodama describes extending a non-coated portion (2) of the positive current collector (5), where the positive lead (3) is disposed, in a direction opposite the lead-attachment surface to accommodate a thicker positive lead (3). EX1007, ¶[0018], [0028]. Kodama’s disclosure (e.g., paragraphs [0018] and [0028]) reflect that the current collector portion at the tab location is effectively indented or deflected relative to the surrounding active material layer to create “a space equal to the thickness of the mixture on both sides” of the current collector to receive the lead tab. EX1007, ¶¶[0018], [0028]. In this manner, the thicker positive lead (3) does not protrude above (or below) Kodama’s active material layer (7). EX1007, ¶¶[0018], [0028]. Kodama teaches that such configuration is helpful to flatten its electrodes, which may prevent air bubbles from forming in Kodama’s battery during electrolyte injection and, thereby, increase the capacity of Kodama’s battery. EX1007, ¶¶[0014]-[0016], [0018],

[0028]. Because Kodama discloses extending the non-coated portion 2 in a direction opposite the surface to which the lead tab is attached, a POSA would have understood that, when the positive lead is disposed on a surface of the current collector facing the battery center, the non-coated portion extends away from the battery center.

c. Sato-Kodama-Takemura Combination

169. In view of Sato's, Kodama's, and Takemura's disclosures, it would have been obvious to a POSA to extend the exposed portion of Sato's positive current collector, as modified by Takemura, away from the center of the battery. Such modification, as taught by Kodama, would accommodate a lead tab having a thickness approximately equal to the overall thickness of the electrode without protruding above the active material layer. EX1007, ¶¶[0015], [0018], [0028]. Accommodating a thicker lead tab within the indented recess of Sato's modified current collector would reduce electrical resistance while avoiding abrupt thickness changes along the electrode's surface. EX1007, ¶¶[0015], [0018], [0028]. Modifying Sato's positive current collector, as modified by Takemura, would have simply been the application of a known technique (extending a non-coated portion of a current collector in a direction opposite the lead tab-attachment surface) to a known device (Sato's battery as modified by Takemura) to achieve the predictable result of improving the battery's storage capacity.

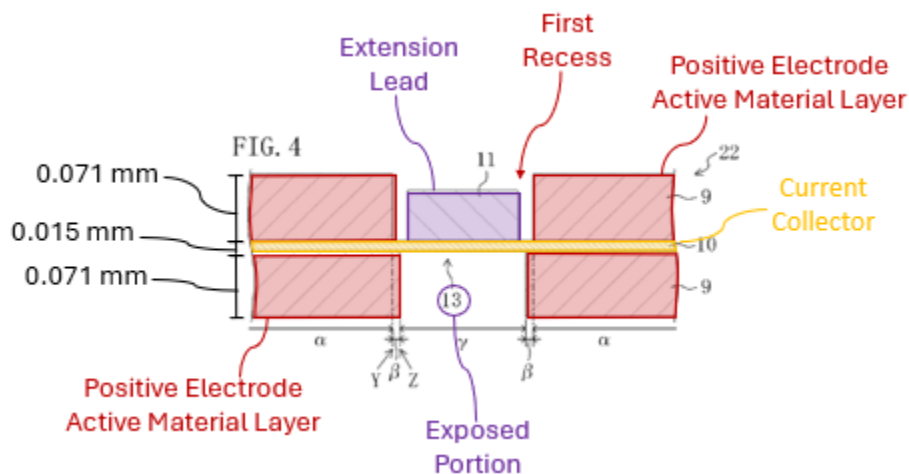
170. Accordingly, a POSA would have understood that the combined disclosures of Sato, Kodama, and Takemura render Elements [3.B]/[13.B] obvious.

I. Claims 6/16 “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.”

171. 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 (10) “with a thickness of 15 μm .” EX1005, ¶[0104]. Accordingly, a POSA would have understood that the combined thickness of Sato’s two positive active material layers (9) is 0.142 mm (.157 mm – 0.015 mm). A POSA would have further understood that the depth of Sato’s first recess, as modified by Kodama, corresponds to the combined thickness of Sato’s two positive active material layers (9). Specifically, a POSA would have understood that the maximum depth of Sato’s first recess, when Sato’s positive current collector (10) is extended in a direction opposite to the lead tab-attachment surface, as modified by Kodama, is 0.142 mm.

172. Based on the disclosed depth of Sato’s first recess, as modified by Kodama, and based on Kodama’s teaching to dispose a lead tab within a boundary of its active materials layers, it would have been obvious for a POSA to select a positive lead thickness 0.005 mm to 0.1 mm thinner than the depth of the recess. In

particular, Kodama teaches that the lead should fit within the recess to produce a substantially smooth electrode profile without protrusion of the tab above the active material layers. EX1007, ¶¶[0018], [0035] (“suppressing the unevenness of the flattened wound electrode body”). Accordingly, a POSA would have understood that choosing the lead thickness to be slightly less than the depth of the recess (e.g., by a small margin such as 0.005–0.1 mm) represents a routine and predictable design choice to ensure proper fit, and avoid localized thickness discontinuities that could otherwise introduce stress concentrations during winding and flattening. EX1007, ¶¶[0014], [0018], [0035].

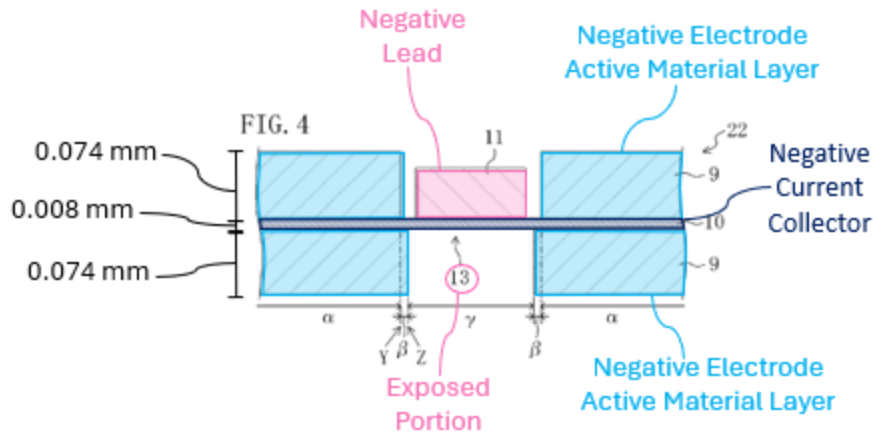


EX1005, FIG. 4 (annotated).

173. 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 (10) “with a thickness of 8 μm .” EX1005, ¶[0107]. Accordingly, a POSA would have

understood that the combined thickness of Sato's two negative active material layers (9) is 0.148 mm (.156 mm – 0.008 mm). A POSA would have further understood that the depth of Sato's second recess, as modified by Kodama, corresponds to the combined thickness of Sato's two negative active material layers (9). Specifically, a POSA would have understood that the maximum depth of Sato's second recess, when Sato's negative current collector (10) is extended in a direction opposite the lead tab-attachment surface, as modified by Kodama, is 0.148 mm.

174. Based on the disclosed depth of Sato's second recess, as modified by Kodama, and based on Kodama's teaching to dispose a lead tab within a boundary of its active materials layers, it would have been obvious for a POSA to select a negative lead thickness 0.005 mm to 0.1 mm thinner than the depth of the recess. Again, a POSA would have understood that choosing the lead thickness to be slightly less than the depth of the recess (e.g., by a small margin such as 0.005–0.1 mm) represents a routine and predictable design choice to ensure proper fit and avoid localized thickness discontinuities that could otherwise introduce stress concentrations during winding and flattening. EX1007, ¶¶[0014], [0018], [0035].



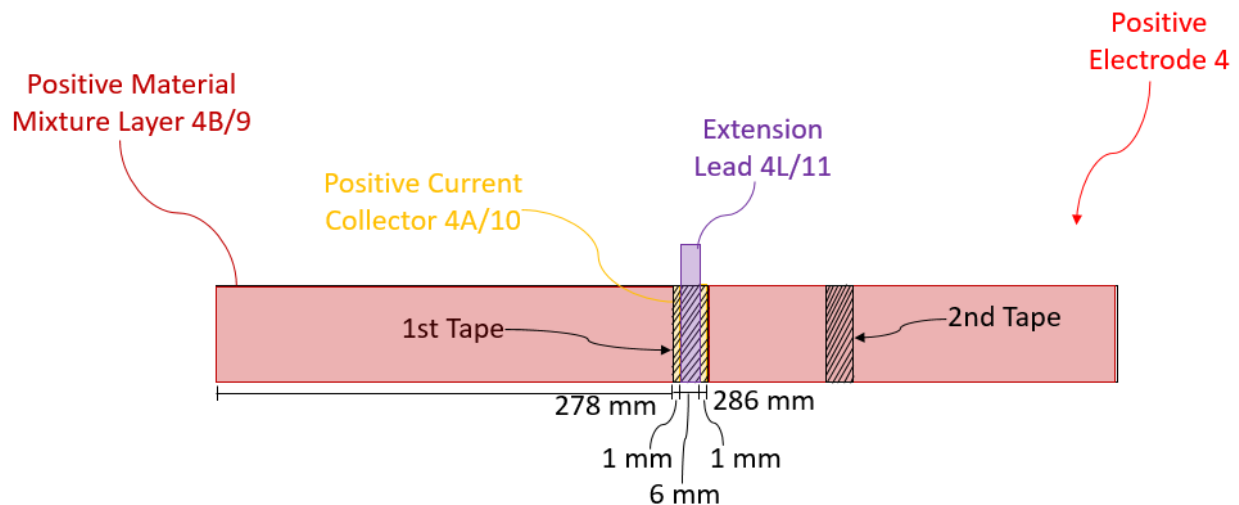
EX1005, FIG. 4 (annotated).

175. Furthermore, simply changing the thickness of Sato's lead to fit within the recess (as modified by Kodama) 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, as modified by Kodama.

J. Claims 8/18 “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.”

176. Sato discloses a width of a portion of the positive lead in the first recess (exposed portion 13) is greater than a width of a remaining portion of the first recess (exposed portion 13) not occupied by the positive lead located on one side of the positive lead. EX1005, ¶¶[0111]-[0112]. 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's Positive Electrode.

177. 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 $1\text{ mm} (\frac{8\text{ mm}-6\text{ mm}}{2})$, which is less than the 6 mm width of Sato’s positive electrode lead.

178. Accordingly, a POSA would have understood that Sato discloses claims 8 and 18.

K. Claim 10

1. [10.A] wherein a top surface of the positive lead is provided with a first insulating glue layer

179. 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]. A POSA would have understood that Sato’s polypropylene adhesive tape corresponds to the recited “first insulating glue layer” because it is an adhesive layer applied directly to the positive lead performing the same insulating function—namely, electrically isolating and protecting the lead from adjacent components—as described in the ’330 patent. EX1001, 1:66-2:5, 3:60-4:3.

180. A POSA would have further understood that Sato’s polypropylene adhesive tape is provided to the top surface of the positive lead 11 within the exposed portion 13. 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 13. EX1005, ¶[0112]. That exposed top surface is the surface protected and insulated by Sato's polypropylene adhesive tape.

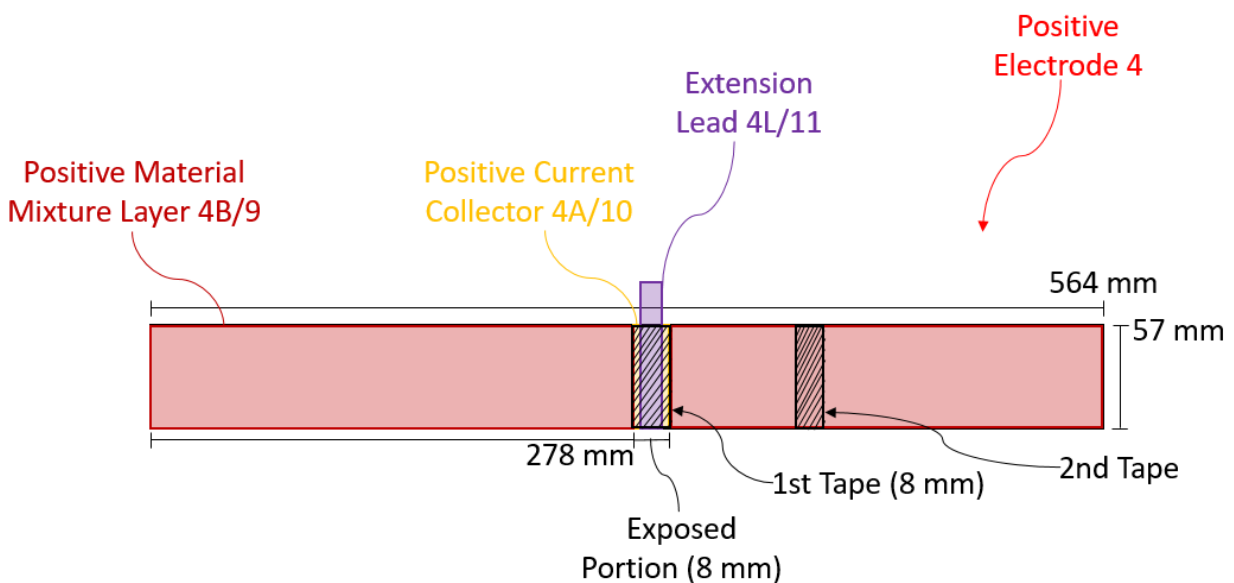
181. As an example, the following annotated figures show Sato's positive electrode plate according to Battery 1 and negative electrode plate according to Battery 8 with dimensions as described in Sato. Sato's positive electrode has "a width of 57 mm" and "a length of 564 mm." EX1005, ¶[0104].⁶ A portion 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

⁶ 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.").

the exposed positive current collector surface remains exposed. EX1005, ¶[0112].

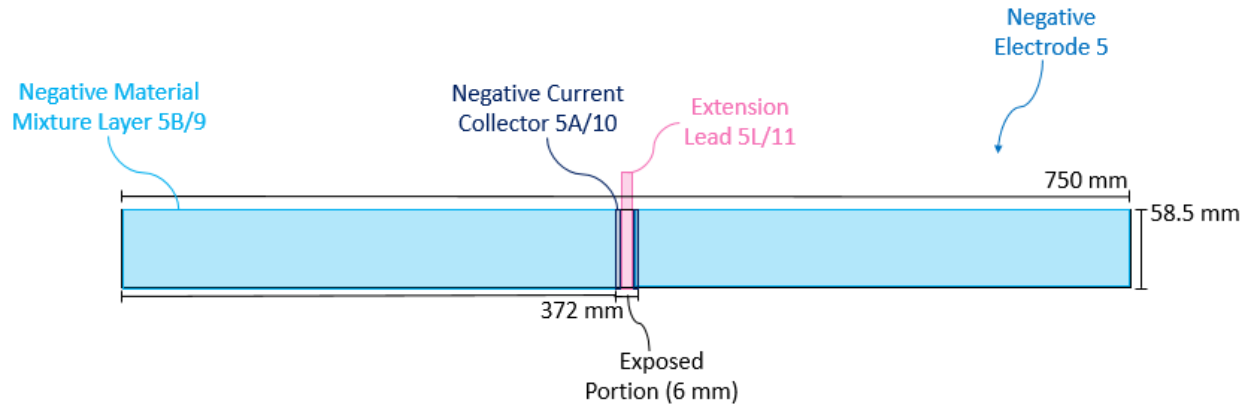
Sato's exposed positive current collector and lead is "protected and insulated" by applying a polypropylene adhesive tape (labeled "1st tape") having a width of 8 mm to the exposed portion of the positive electrode plate, as shown below.

EX1005, ¶[0113]. 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.⁷

⁷ 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



Sato's Negative Electrode.

182. Accordingly, a POSA would have understood that Sato discloses Element [10.A].

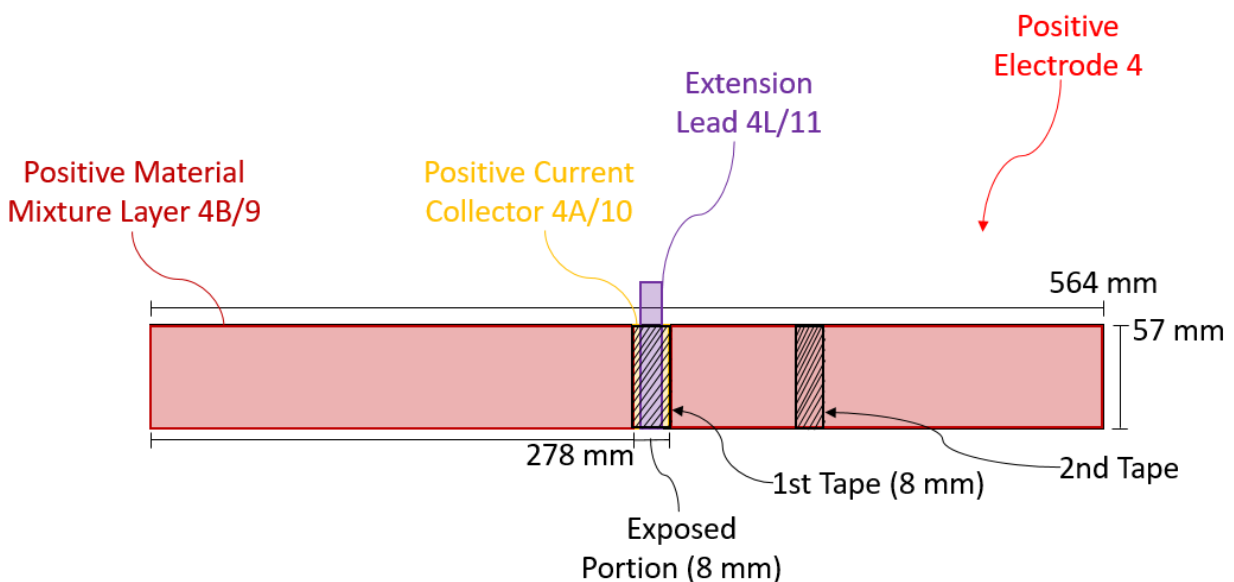
2. **[10.B] a surface of the positive electrode active material layer corresponding to the second recess is pasted with a second insulating glue layer,**
 - a. **Sato**

183. 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]. A POSA would have understood that Sato's polypropylene adhesive tape corresponds to the recited “second

of Sato's position electrode plate would depend on the location of the second recess 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.

insulating glue layer” because it is an adhesive layer applied on the positive electrode performing the same insulating function—namely protecting the negative lead from lithium deposition—as described in the ’330 patent. EX1001, 1:66-2:5, 3:60-4:3.

184. 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.

185. 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 corresponding to the second recess ” 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 13 (recess) where Sato’s negative lead 11 is located to avoid lithium plating.

186. 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 corresponding 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].

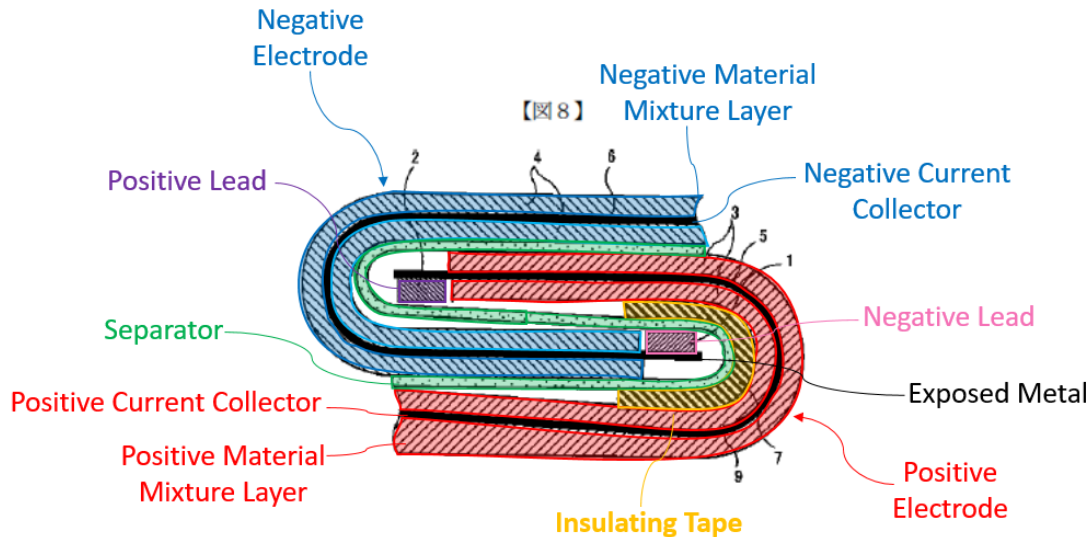
187. Applying Sato's additional polypropylene adhesive tape on the positive active material at any location other than opposite to the recess in the negative active material across the separator would likely have had no effect on potential lithium plating. Again, lithium plating occurs at exposed metal 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.

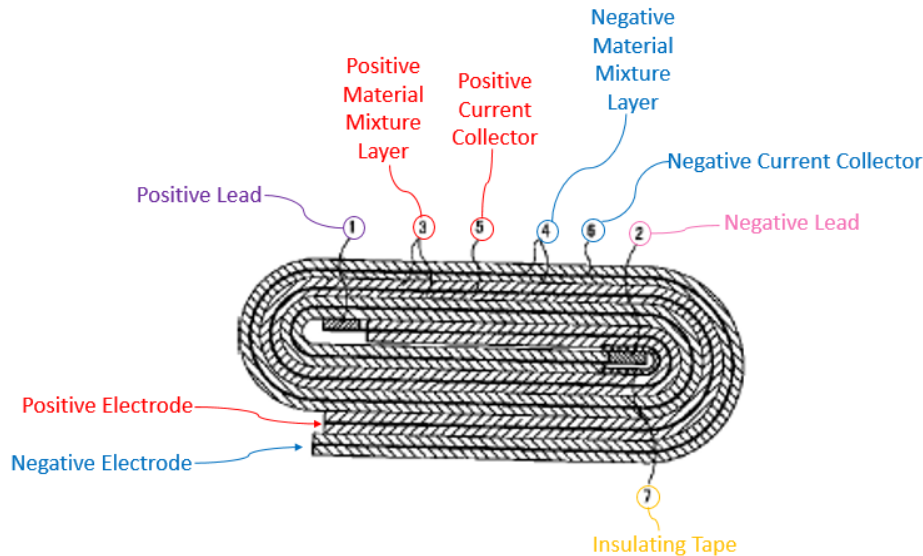
b. Takemura

188. To the extent Sato does not explicitly disclose attaching the additional tape on "a surface of the positive electrode active material layer corresponding to the second recess," Takemura discloses that such positioning would have been obvious.

189. 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 and 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. Takemura further explains “if there is no opposing negative electrode active material 4, such as the positive electrode active material 3 arranged around the negative electrode current collector terminal 2 in FIG. 9, the surface of the positive electrode active material 3 has to be covered with masking tape 7.” EX1006, ¶[0008]. That is, Takemura expressly teaches that insulating tape must be positioned on the positive active material opposite exposed metal on the negative current collector to effectively prevent lithium plating.





EX1006, FIGs. 8, 9 (annotated).

c. Sato-Kodama-Takemura Combination

190. 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 corresponding to the second recess." Positioning the additional tape at this location would prevent lithium plating by overlapping exposed metal on Sato's negative current collector (5A/10).

191. Lithium plating within lithium-ion batteries was a known problem well before the filing date of the '330 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).

192. 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 '330 patent. EX1005, ¶[0137]; EX1006, ¶[0008]; EX1009, ¶[0017]; EX1016, ¶[0014]. Both Sato and Takemura disclose insulating the positive active material opposite to exposed metal on the negative electrode as one of those known solutions for preventing 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.

193. To the extent that Sato does not explicitly disclose all the claimed features of the '330 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].

194. 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 current collector 5A/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 to prevent 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.

195. Furthermore, a POSA would have understood that Takemura's teachings regarding lead tab orientation in Figure 4 and insulating tape placement in Figures 8 and 9 are both applicable to Sato's battery. Because these teachings address independent but complementary battery design parameters—battery safety and electrode layout—a POSA would have the skill to combine them, applying the insulating tape placement of Figures 8 and 9 to the lead tab configuration shown in Figure 4. Regardless of whether a negative lead tab is facing toward or away from the battery center, a POSA would have understood in view of Sato and Takemura that lithium plating can occur if the negative lead tab is exposed to positive active material. This understanding would have motivated a POSA to look to Takemura's teachings regarding specific techniques for mitigating lithium plating, including the use of insulating tape, as discussed below.

196. Takemura teaches two alternative techniques for preventing lithium plating: (1) placing insulating tape 7 on the portion of positive active material layer 3 opposite negative lead 2, as shown in Figures 8 and 9, and (2) removing the portion of the positive active material layer 3 opposite negative lead 2, as shown in Figures 1-6. EX1006, ¶¶[0003], [0008], [0018]-[0020], [0035]. Takemura confirms these approaches are interchangeable, stating that “positive electrode active material layer 3 opposite the beginning of the winding end of the negative electrode is covered with insulating tape 7 to prevent lithium metal deposition, but

instead of covering it with insulating tape 7, the active material in this portion may be removed.” EX1006, ¶[0021]. Thus, Takemura’s solutions for preventing lithium plating are not limited to a particular illustrated embodiment. Instead, Takemura teaches the general concept: when positive active material faces a negative lead/current collector region, that region should be protected from lithium plating either by applying tape or removing active material. EX1006, ¶¶[0003], [0008], [0018]-[0020], [0035]. A POSA therefore would have appreciated that Takemura’s insulating tape placement shown in Figures 8 and 9 can be readily implemented with the lead tab orientation shown in Figure 4, without requiring any modification to the underlying lead orientation.

197. A POSA would have further understood that there are practical advantages to using tape instead of removing active material, namely that applying insulating tape ensures safety in battery performance while avoiding the problematic processing steps associated with removing active material. *See* Section VII.C; EX1010, ¶¶[0007], [0032] (describing that “protective tape” can “be simply and easily affixed at a fixed position without shifting, and that effectively prevents electrical contact between opposing electrode tabs and plates.”); EX1042, ¶¶[0004]-[0008]; EX1043, 2:32-4:22 (describing the state of art for providing “noncoated portions” on the electrode plate, including the “difficult[y] to exactly form a pattern of the non-coated portion at a high speed,” with the risk of a buildup

(protruded) edge portion of the active material layer,” and the “difficult[y] to make smooth the edge portions of the active material layer.”). In the ’498 IPR proceeding, Patent Owner’s declarant Mr. Kaschmitter acknowledged that insulating tape was commonly used to prevent lithium deposition and that active material removal processing creates issues, such as “uneven edges in the active material” and “burrs.” EX1039, 30:13-22, 46:2-10, 46:22-47:25. Accordingly, a POSA would have been motivated to implement Takemura’s insulating tape placement of Figures 8 and 9, instead of removing active material, because doing so provides the same lithium-plating mitigation benefit while avoiding the complications of removing active material.

198. Given that Sato already discloses the use of insulating tape (EX1005, ¶[0137]), a POSA would have looked to other prior art teachings (Takemura’s Figures 8 and 9) on tape placement (i.e., location and sizing). Furthermore, a POSA would have recognized that Takemura’s disclosure related to tape placement and sizing (EX1006, ¶[0008]) would inform a POSA how to place and size the additional tape on the positive active material within Sato’s battery to prevent lithium plating. A POSA would have understood that proper placement of the insulating tape is critical to achieving this intended safety benefit. Thus, even to the extent Sato does not expressly disclose positioning its second insulating glue layer at a location “corresponding to the second recess,” a POSA would have been

motivated to modify the location of Sato's insulating adhesive to that position based on the teachings of Takemura's battery shown in Figures 8 and 9.

199. A POSA would have had a reasonable expectation of success in doing so with Takemura's lead tab configuration of Figure 4 because applying insulating tape as shown in Figures 8 and 9 of Takemura would not alter the underlying interface between the lead tab and the current collector. As I discussed above and based on my experience in the field, insulating tapes were widely used in lithium-ion batteries to cover exposed metal and mitigate short-circuiting risks, and their functional effect. *See* Section VII.C. Because Takemura teaches placing such tape precisely at the location where lithium plating is known to occur, a POSA would have had confidence that implementing this known placement in Sato would perform its intended function without affecting the connection between the lead tab and the current collector. This modification would have amounted to nothing more than applying known techniques (Takemura's tape placement in Figures 8-9 and lead tab configuration in Figure 4) to a known device (Sato's battery) to yield the predictable result of preventing lithium plating at a known position. Accordingly, a POSA would have understood that the combined disclosures of Sato, Kodama, and Takemura render Element [10.B] obvious.

3. **[10.C] 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

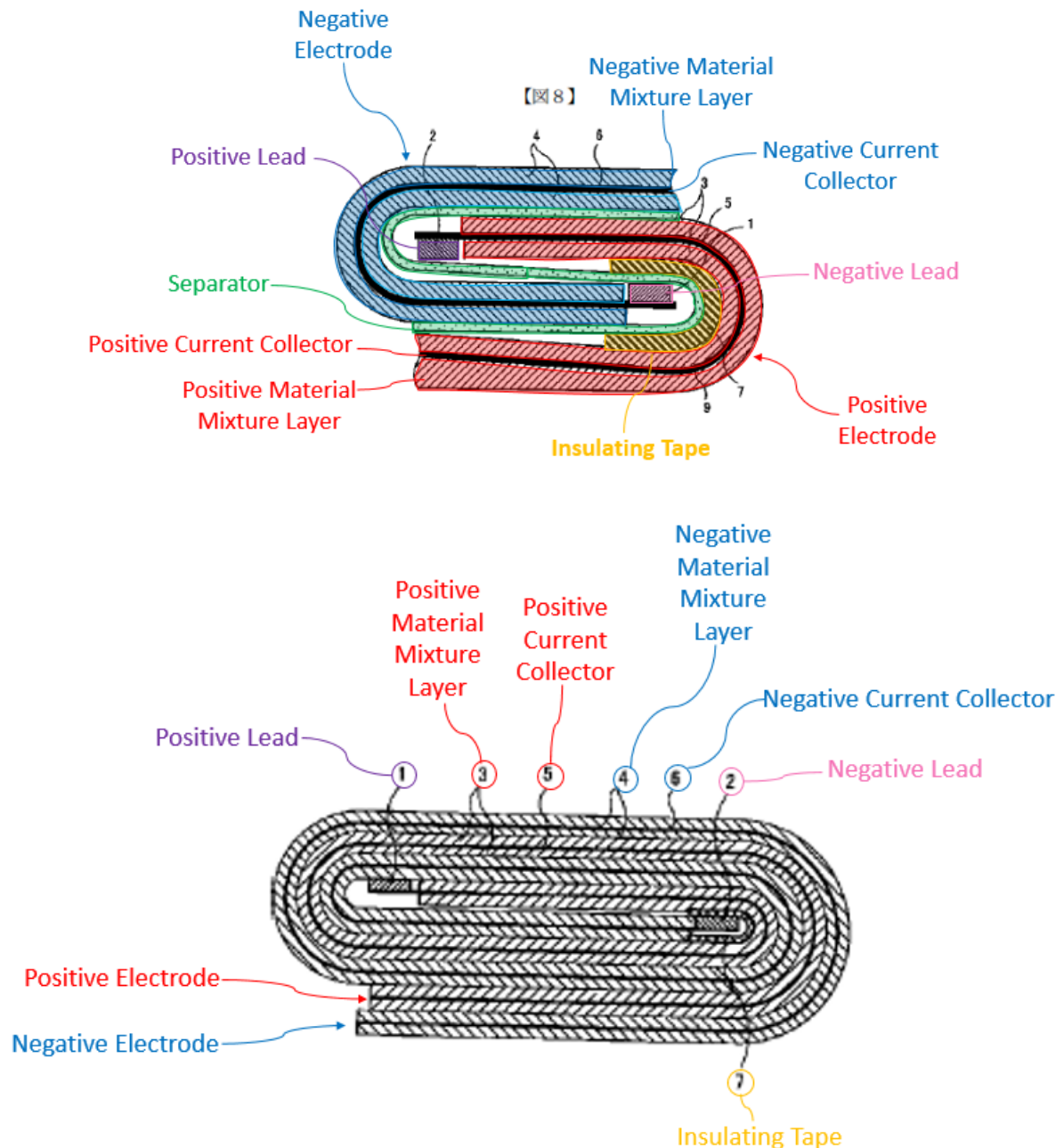
a. Sato

200. 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

201. 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 Figures 8 and 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, FIGs. 8, 9 (annotated).

202. 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.

203. 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. Indeed, Takemura discloses "the surface of the positive electrode active material 3 has to be covered with masking tape 7 ... so that there is virtually no positive electrode active material 3 facing the negative electrode active material 4." EX1006, ¶[0008]. In view of Takemura's teachings (EX1006, ¶[0008]), 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 a result of alignment variances. EX1010, ¶[0019] (tape wider to insulate even if placement “deviates slightly relative to the position of the second electrode tab”); 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”). Additional prior art underscores what Takemura’s teachings convey to a POSA: extend tape beyond the recess’s width and length, ensuring insulation even with misalignment. EX1008, Figures 2A-B (insulating tape extends beyond recess length and width); EX1010, ¶[0019]; EX1027, ¶[0227]-[0228], FIGS. 23, 25. In IPR2025-00389 of the related ’498 patent, Patent Owner’s declarant Mr. Kaschmitter admitted that it was common practice to “increas[e] the size of the tape” in lithium-ion batteries to “account for potential misalignment” between the electrodes to avoid the catastrophic risk of short-circuiting. EX1039, 38:23-39:8, 25:18-21, 27:4-28:2.

c. Sato-Kodama-Takemura Combination

204. 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 13 (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 13 was properly isolated from positive active material to avoid lithium plating. Because safety considerations outweigh all other design factors, a POSA would have had every reason to extend Sato's tape wider and longer than its second recess, in view of Takemura's teachings, to avoid the catastrophic consequences of short-circuiting caused by lithium plating.

205. 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 13 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 13 would also have been necessary to ensure that metal in the exposed portion 13 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.

X. GROUND 2: CLAIMS 4, 5, 7, 14, 15, AND 17 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO, TAKEMURA, KODAMA, AND NAKAMURA.

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

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

B. Japanese Patent Pub. No. 2000-067907 to Takemura *et al.* (Takemura)

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

C. Japanese Patent Pub. No. 2004-303950 to Kodama *et al.* (Kodama)

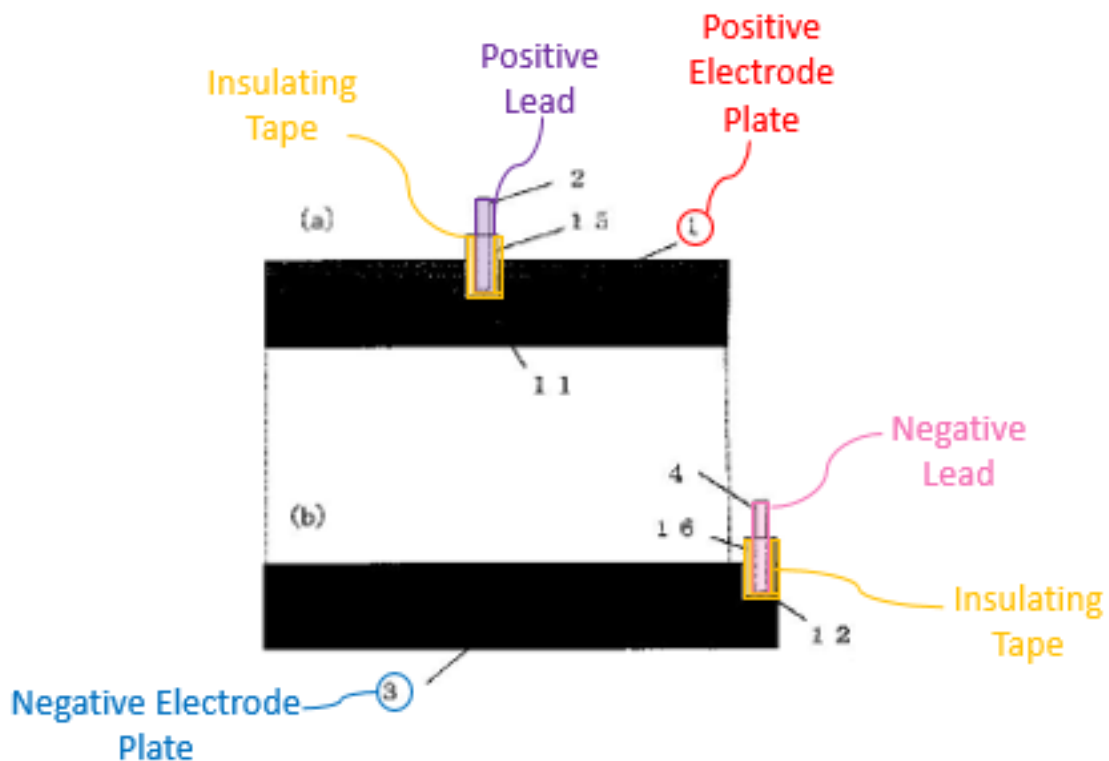
208. Kodama discloses a lithium-ion battery as I discussed above in Section IX.C.

D. Japanese Patent Pub. No. 2003-068271 to Nakamura *et al.* (Nakamura)

209. Japanese Patent Pub. No. 2003-068271 to Nakamura *et al.* published on March 7, 2003. Nakamura's publication date precedes the '330 patent's earliest effective filing date of January 17, 2014, by over 10 years.

210. Nakamura discloses a "lithium secondary battery" similar to those described in Sato and the '330 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

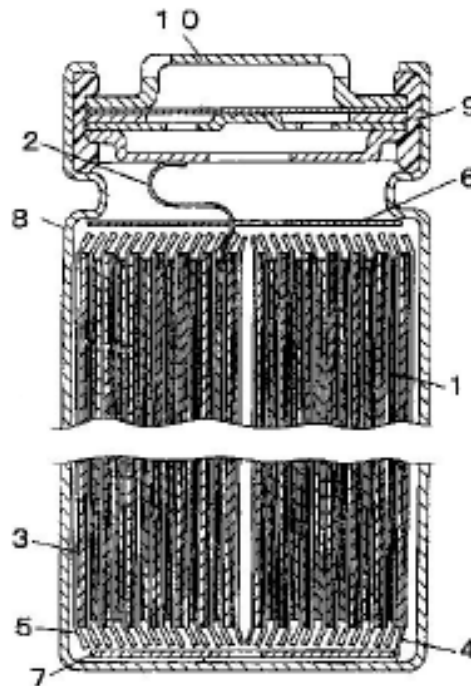
current collector. EX1012, ¶[0012]. Nakamura's lithium-ion battery also includes a negative electrode plate 3 formed by a negative electrode current collector and a negative electrode active material applied to the surfaces of negative current collector. EX1012, ¶[0029]. Nakamura's lithium-ion battery 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).

211. Nakamura discloses similar fabrication attributes as Sato, Kodama, Takemura, and the '330 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.

212. 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

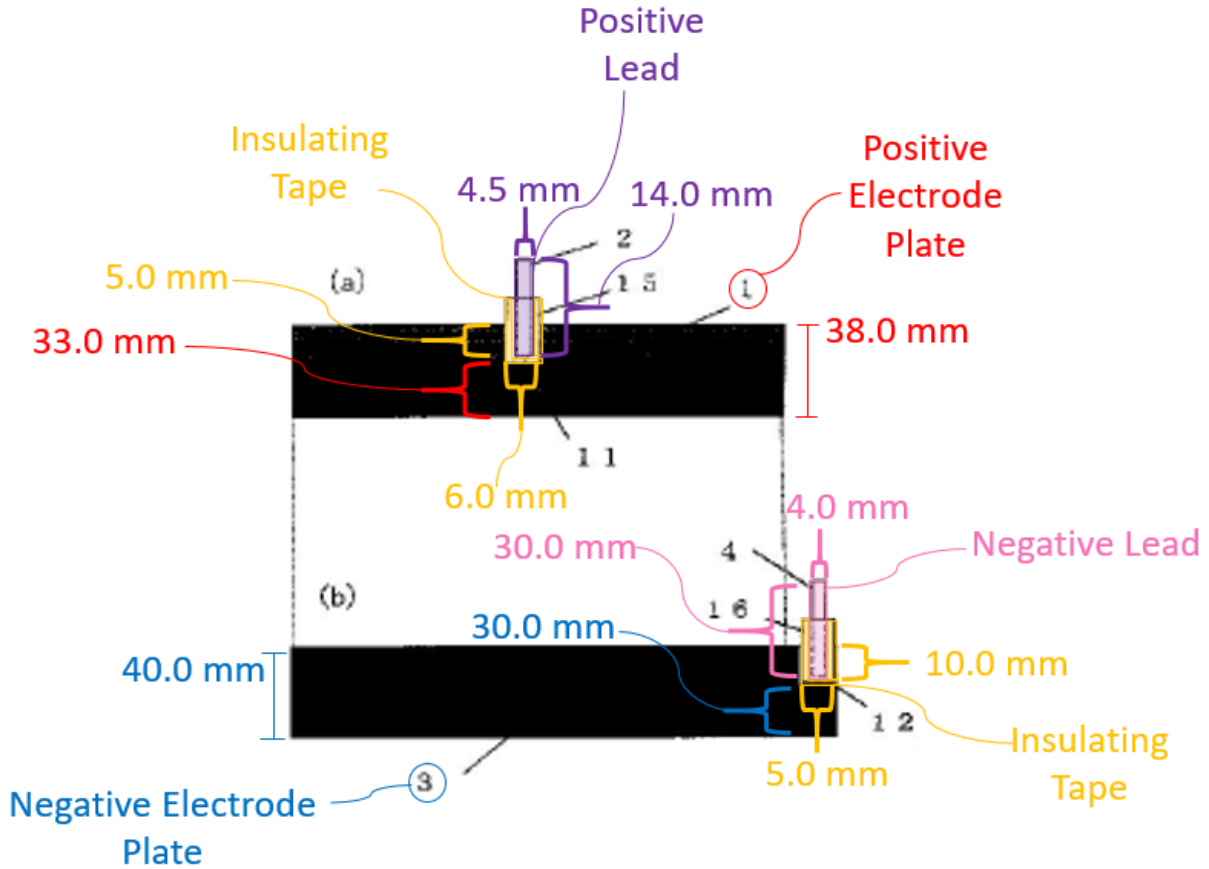
first recess), Nakamura discloses maintaining the width of active material-free portion 11 in a range from 5 mm to 15 mm and the length of active material-free portion at 6 mm. EX1012, ¶¶[0027], [0052]. Similarly, Nakamura discloses maintaining the length of the negative active material-free portion 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].

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

213. Nakamura, Sato, Kodama, and Takemura are analogous art with respect to the '330 patent, as they all disclose lithium-ion batteries. EX1005, ¶[0001]; EX1006, ¶[0001]; EX1007, ¶[0001]; EX1012, ¶[0007]; EX1001, Abstract. Each of Nakamura, Sato, Kodama, and Takemura disclose non-aqueous electrolyte lithium-ion battery cells with insulating tapes configured to enhance reliability and prevent safety hazards within the battery cells. EX1005, ¶¶[0010], [0113]; EX1006, ¶[0003]; EX1007, ¶¶[0004], [0017]-[0018], [0020], [0026]-[0028]; EX1012, ¶¶[0025], [0028], [0034]-[0035], [0054].

214. 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].

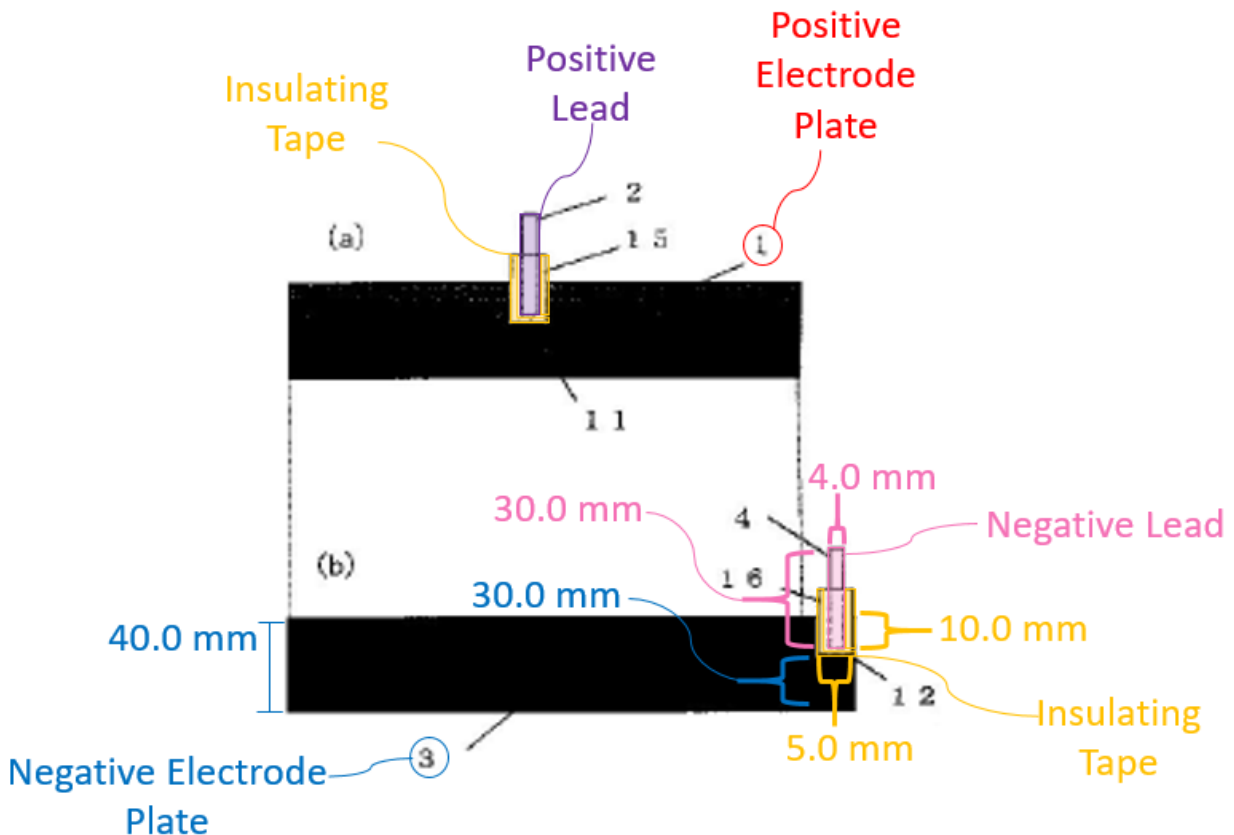
215. Specifically, Nakamura discloses the width (measured along a length direction of the positive electrode plate) of positive active material-free portion 11 (i.e., a first recess) to be “1 mm to 2 mm wider than the width of the positive electrode lead 2 in the longitudinal direction.” EX1012, ¶27. For example, Nakamura discloses providing a positive active material-free portion 11 (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).

216. 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).

217. To the extent that Sato does not explicitly disclose all the claimed ranges of dimensions for the recesses of the '330 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.

218. A POSA would also have had a reasonable expectation of success in combining the teachings of Nakamura with Sato, Kodama, 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 Kodama, Takemura, and Nakamura, to perform their intended function. Modifying the length of Sato's recesses to be less than the width of the current collector, as taught by Nakamura, does not negate Sato's staggered edges of active materials

disposed on opposite sides of the current collector, thereby allowing Sato's modified electrodes to continue to bend, rather than break, during crush test. Sato never requires that the exposed portion must extend across the entire width of the electrode plate, and Nakamura never suggests altering the dimensions of the recess located opposite to the recess accommodating the lead. Thus, combining the teachings of Nakamura's recess dimensions with Sato's battery, as modified by Kodama and 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 Kodama and Takemura—to achieve the expected result of increasing the battery's storage capacity.

F. Claims 4/14 “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-[1.00/100]⁸ 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.”

1. Sato

219. For one example battery (Battery 1), Sato discloses the first recess

⁸ The recitation “1–1.00 mm” in claim 14 appears to be a typographical error that should read “1–100 mm.” This is consistent with the corresponding limitation recited in claim 4 (EX1001, 11:19-22) and the specification (EX1001, 3:46-49), both of which recite a range of “1–100 mm less than a length of the negative lead.”

(exposed portion 13 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 13 on positive electrode 4) has a width that is 2 mm larger than the width of positive lead 4L/11.

220. Furthermore, Sato discloses the second recess (exposed portion 13 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 13 on negative electrode 5) has a width that is 2 mm larger than the width of negative lead 5L/11.

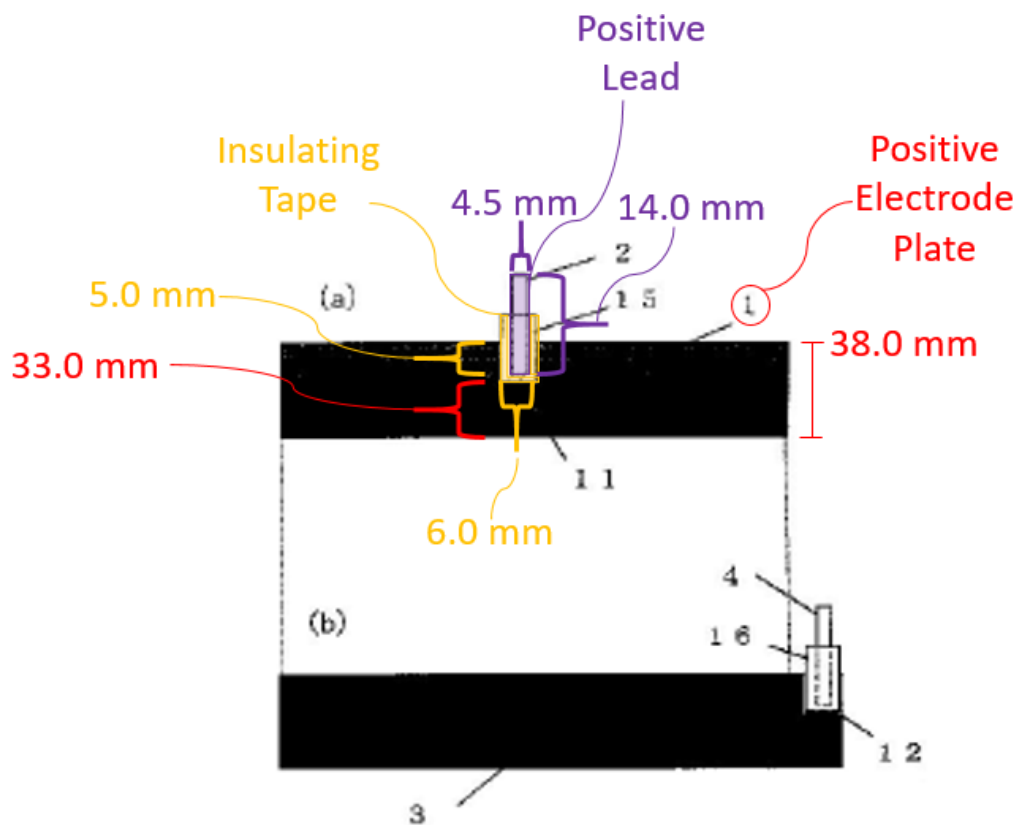
221. Sato is silent about “the first recess has a length of 1-100 mm less than a length of the positive lead” and “the second recess has a length of 1-100 mm less than a length of the negative lead.” However, providing recesses on positive and negative electrodes with a length of 1-100 mm less than a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

2. Nakamura

222. 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 claims 4 and 14 would have been obvious.

223. 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).



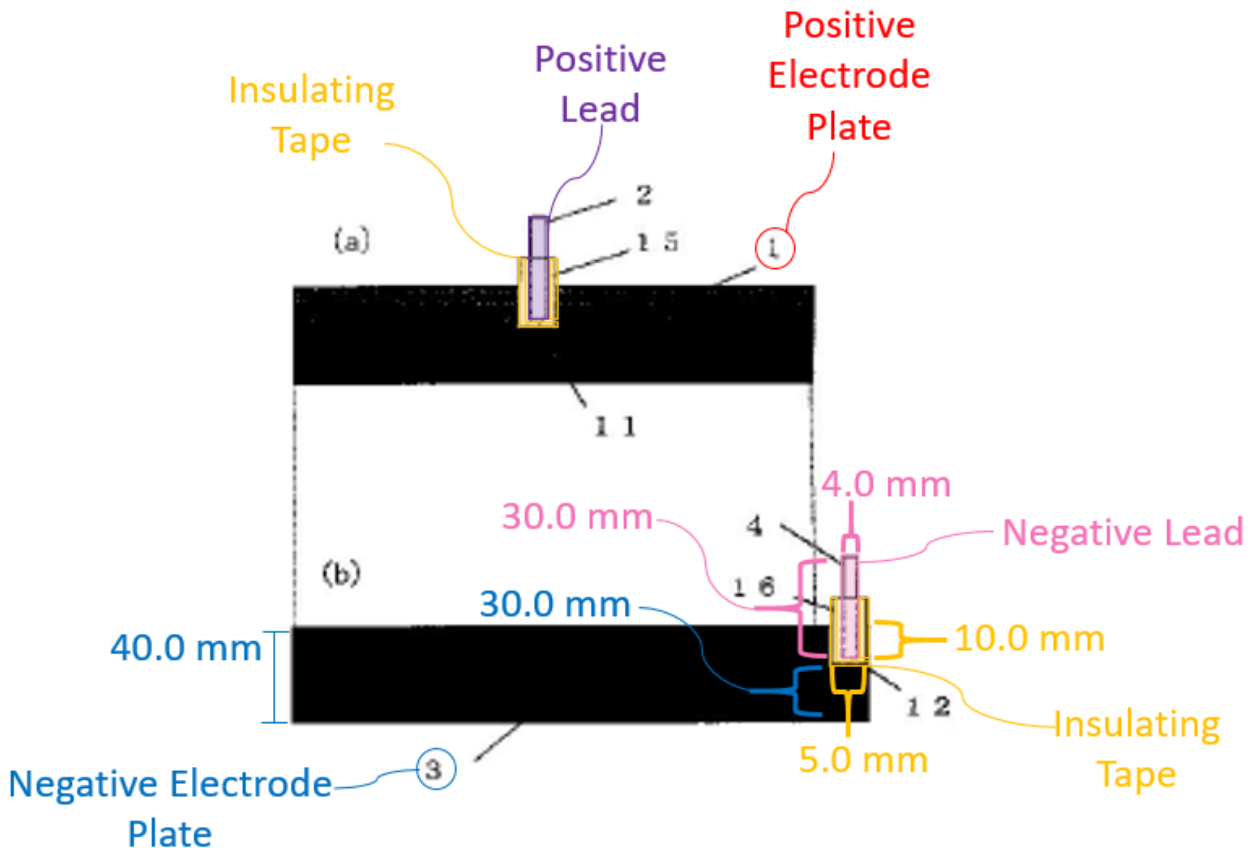
EX1012, FIG. 1 (annotated).

224. 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].⁹ 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

⁹ There is a discrepancy in Nakamura's written disclosure regarding the length dimension of the second recess (measured along the width of Nakamura's 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 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).

225. 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 recess dimensions that overlap the

¹⁰ As I explained above in footnote [9] 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 claims 4 and 14.

3. Sato-Kodama-Takemura-Nakamura Combination

226. In view of Sato's, Kodama'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 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 Kodama and 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.

227. Accordingly, a POSA would have understood that the combined disclosures of Sato, Kodama, Takemura, and Nakamura render claims 4 and 14 obvious.

- G. Claims 5/15 “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.”**

1. Sato

228. 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.

229. 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.

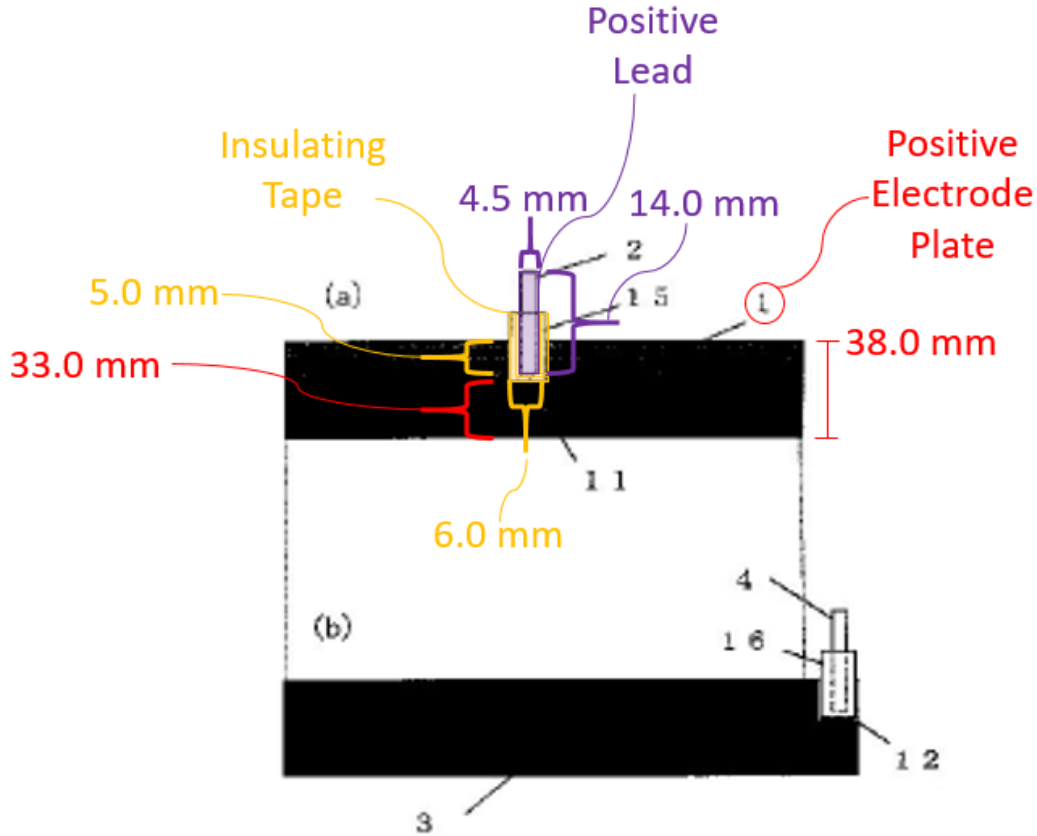
230. Sato is silent about “the first recess has a length of 1-100 mm less than a width of the positive electrode active material layer” and “the second recess has a length of 1-100 mm less than a width of the negative electrode active material layer.” However, providing recesses on positive and negative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

2. Nakamura

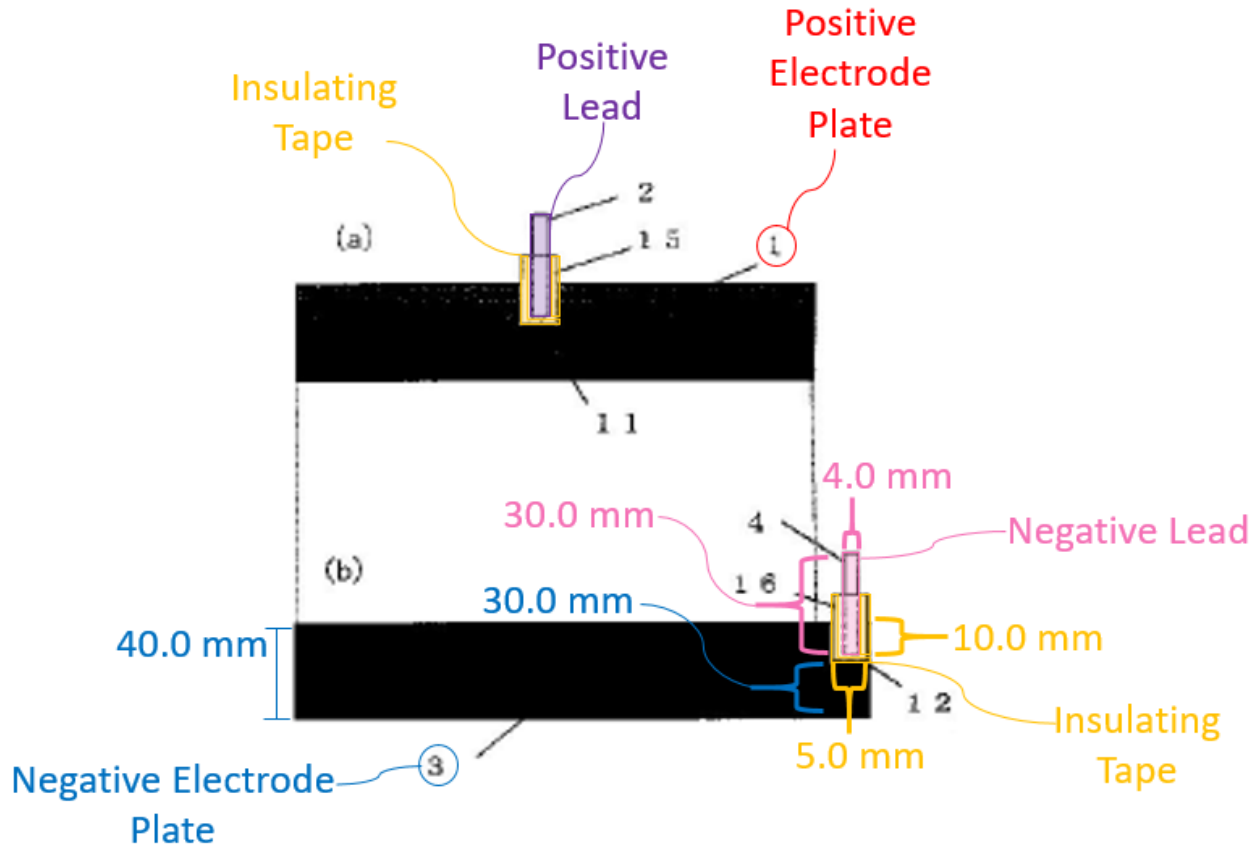
231. To the extent Sato does not explicitly disclose the first recess having a length of 1-100 mm less than a width of a positive electrode active material layer and the second recess having a length of 1-100 mm less than a width of a positive electrode active material layer, Nakamura discloses that modifying the length of the electrode's recesses to be within the recited dimension ranges of claims 5 and 15 would have been obvious.

232. 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).

233. 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).

234. 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 portion 12

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 first and second recess dimensions that overlap the recess dimension ranges recited in claims 5 and 15.

3. Sato-Kodama-Takemura-Nakamura Combination

235. In view of Sato’s, Kodama’s, Takemura’s, and Nakamura’s disclosures, it would have been obvious to a POSA to form the length of Sato’s

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, thereby increasing the capacity of Sato's battery, as modified by Kodama and 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 Kodama and Takemura) to achieve the predictable result of improving the battery's storage capacity and reducing manufacturing costs.

236. Accordingly, a POSA would have understood that the combined disclosures of Sato, Kodama, Takemura, and Nakamura render claims 5 and 15 obvious.

- H. Claims 7/17 “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 a 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.”**

1. Sato

237. 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.

238. 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, ¶[0112].

239. Sato is silent about the dimensions of the positive electrode’s exposed portion 13 (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.”

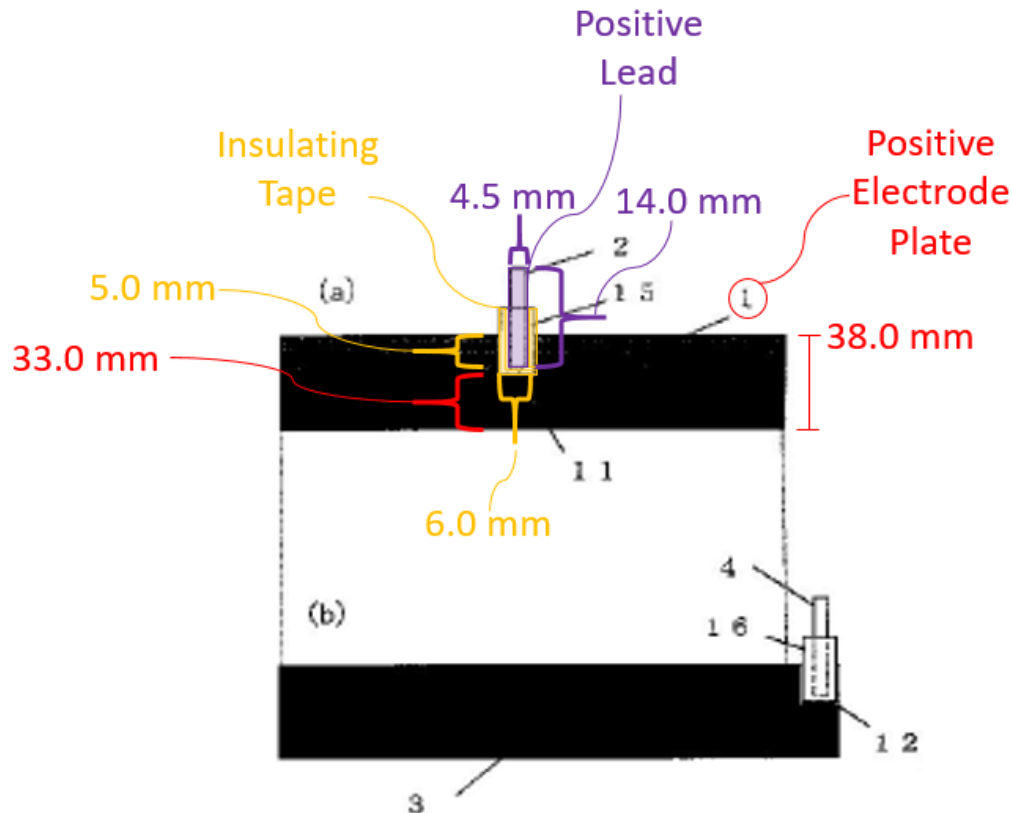
240. However, providing a lead in a first recess of a positive electrode with a length less than a width of a remaining portion of the positive electrode active material layer from an edge of the first insulating tape covering the positive electrode active material layer to an edge of the positive electrode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

2. Nakamura

241. To the extent Sato does not explicitly disclose the recited dimension ranges of claims 7 and 17, 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 17 would have been obvious.

242. 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).

243. 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.

244. Thus, Nakamura discloses active material layer and recess dimensions that overlap the active material and recess dimensions ranges recited in claims 7 and 17.

3. Sato-Kodama-Takemura-Nakamura Combination

245. In view of Sato's, Kodama'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 13 (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 13. Modifying the dimensions of Sato's exposed portion 13 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 Kodama and 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 13 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 Kodama and Takemura) to achieve the predictable result of improving the battery's storage capacity.

246. Accordingly, a POSA would have understood that the combined disclosures of Sato, Kodama, Takemura, and Nakamura render claims 7 and 17 obvious.

XI. GROUND 3: CLAIMS 9, 19, AND 20 WOULD HAVE BEEN OBVIOUS IN VIEW OF SATO, TAKEMURA, KODAMA, AND KOBAYASHI.

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

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

B. Japanese Patent Pub. No. 2000-067907 to Takemura *et al.* (Takemura)

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

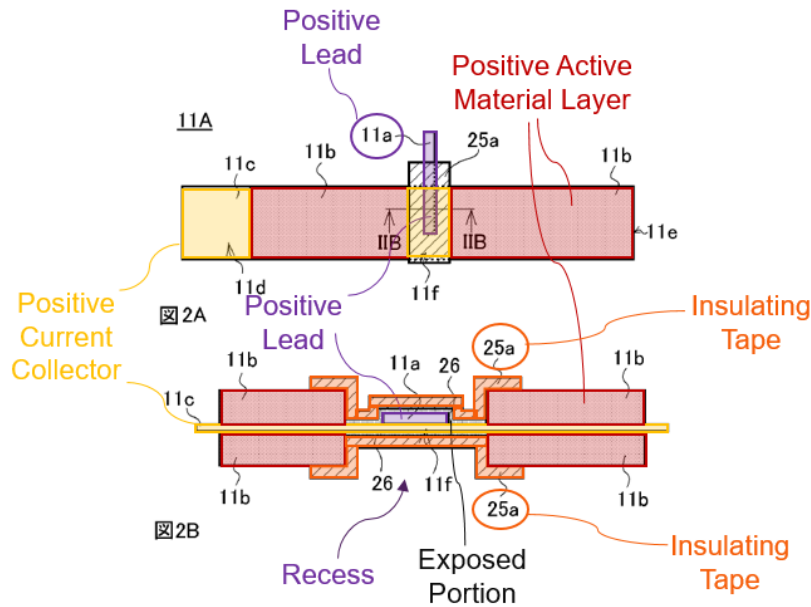
**C. Japanese Patent Pub. No. 2004-303950 to Kodama et al.
(Kodama)**

249. Kodama discloses a lithium-ion battery as I discussed above in Section IX.C.

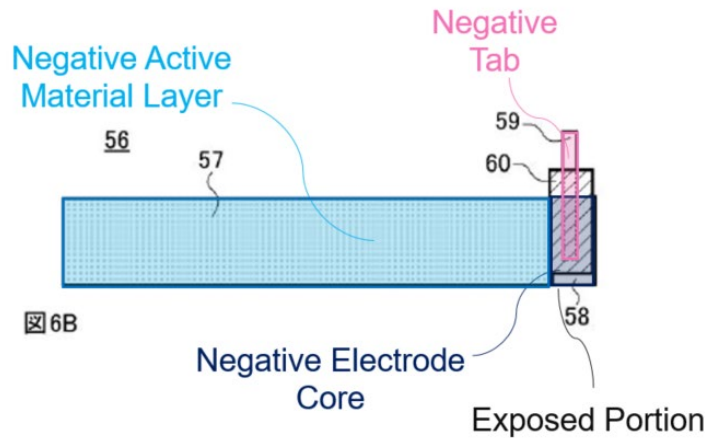
**D. Japanese Patent Pub. No. 2010-055906 to Kobayashi et al.
(Kobayashi)**

250. Japanese Patent Pub. No. 2010-055906 to Kobayashi et al. published on March 11, 2010. Kobayashi's publication date precedes the '330 patent's earliest effective filing date of January 17, 2014, by almost three years.

251. 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, ¶¶[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 58 of metal foil and a negative current collecting tab 59 attached to the exposed portion 58 of metal foil. EX1008, ¶[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-2B (annotated).



EX1008, FIG. 6B (annotated).

252. 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].

253. 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].

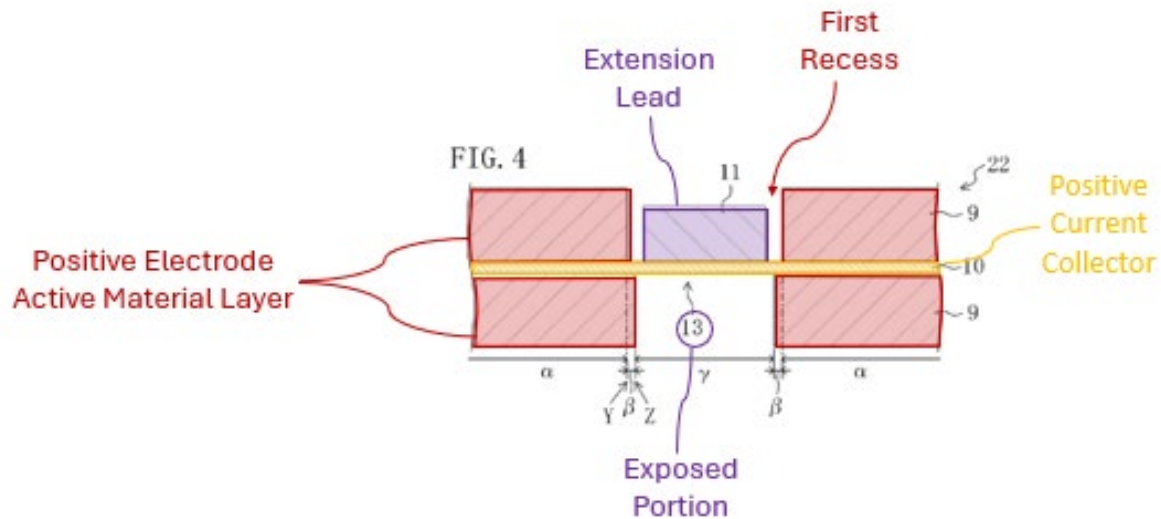
E. A POSA would have been motivated to combine Kobayashi with Sato, Kodama, and Takemura with a reasonable expectation of success.

254. Kobayashi, Sato, Kodama, and Takemura are analogous art with respect to the '330 patent, as they all disclose lithium-ion batteries. EX1005,

¶[0001]; EX1006, ¶[0001]; EX1007, ¶[0001]; EX1008, ¶¶ [0014]-[0016]; EX1001, Abstract. Each of Kobayashi, Sato, Kodama, and Takemura disclose non-aqueous electrolyte lithium-ion battery cells with insulating tapes configured to enhance reliability and prevent safety hazards within the battery cells. EX1005, ¶¶[0010], [0113]; EX1006, ¶[0003]; EX1007, ¶¶[0004], [0017]-[0018], [0020], [0026]-[0028]; EX1008, ¶[0013].

255. 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]. Kodama also discloses insulating tapes configured to cover its tabs to prevent short-circuiting. EX1007, ¶[0008]-[0011]. 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].

256. As shown below in Figure 4, Sato describes exposing a surface (portion 13) 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, FIG. 4 (annotated).

257. 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—a surface of the positive current collector corresponding to the positive lead—with another polypropylene adhesive tape. 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 a third insulating tape was well known, as evidenced by Kobayashi.

258. 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

¶¶[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].

260. A POSA would have been motivated to cover the exposed portion 13 of Sato’s positive current collector 4A/10 opposite to the current collector surface connected to positive lead 4L/11—a surface of the positive current collector corresponding to the positive lead—with a third 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 13 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

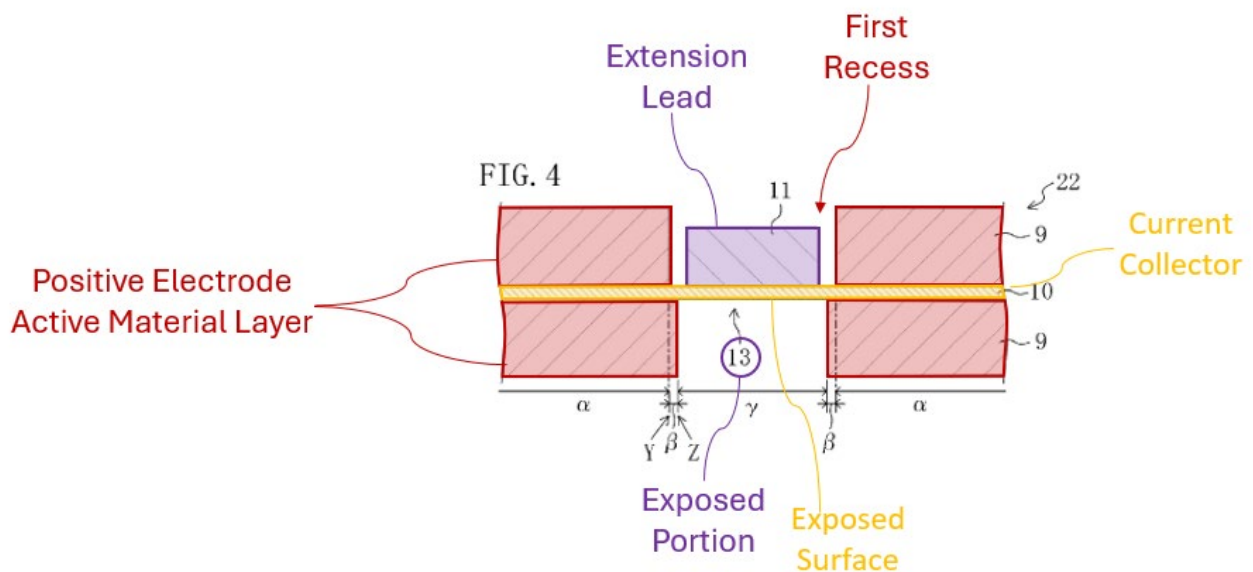
POSA would have been motivated to include an insulating tape to cover this exposed portion 13 of Sato's positive current collector 4A/10, as taught by Kobayashi, to prevent short-circuiting, and thus improve reliability and safety.

261. A POSA would also have had a reasonable expectation of success combining the teachings of Sato, Kodama, and Takemura with Kobayashi. Again, insulating tapes were common in 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 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-Kodama-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-Kodama-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-Kodama-Takemura's battery) to yield the predictable result of preventing short-circuiting.

F. Claim 9 “wherein a surface of the positive current collector corresponding to the positive lead is covered with a third insulating glue layer.”

1. Sato

262. Sato discloses an exposed bottom surface (12/14) of positive current collector 4A/10 that is opposite the surface of the positive current collector connected to positive lead 4L/11.



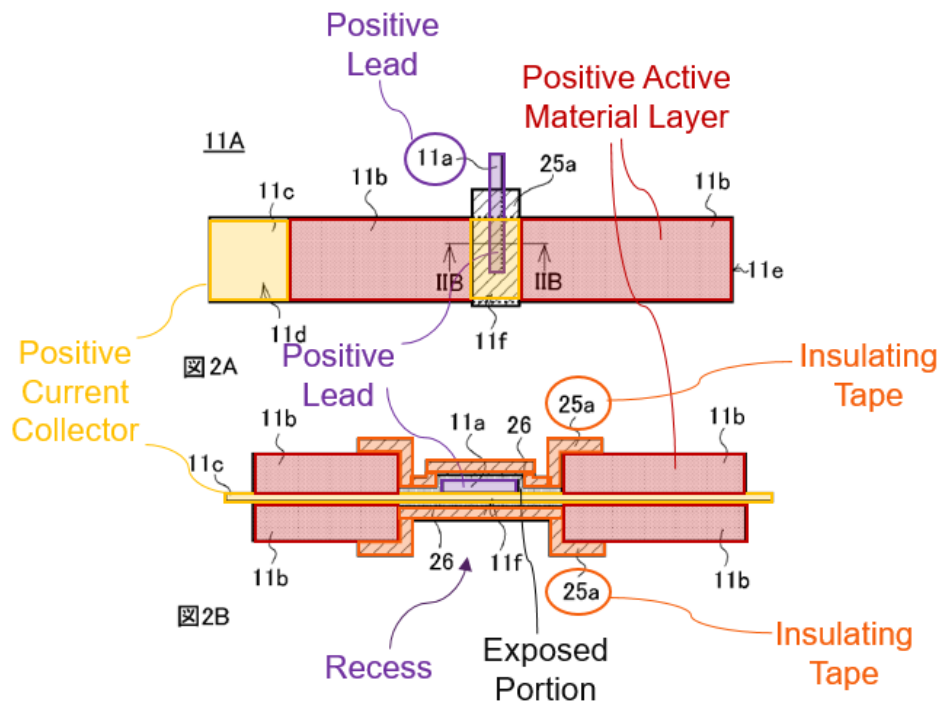
EX1005, FIG. 4 (annotated).

263. While Sato describes covering the top surface of positive current collector connected to the positive lead with a first insulating tape, Sato does not explicitly disclose covering the opposite, bottom exposed surface of positive current collector with another insulating tape. But this would have been obvious in view of Kobayashi.

2. Kobayashi

264. As discussed in Section XI.D, Kobayashi discloses covering a third location 11f of a surface of the positive current collector 11c opposite the surface of the positive current collector 11c connected to the positive lead 11a—a surface of the positive current collector corresponding to the positive lead—with another insulating glue layer—Kobayashi’s insulating tape 25a—as recited in claim 9.

EX1008, ¶¶[0034]-[0035].



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

3. Sato-Kodama-Takemura-Kobayashi Combination

265. As discussed in Section XI.E, it would have been obvious 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 Sato's positive active material edges. EX1008, ¶¶[0005], [0010], [0014]. This modification would have simply been combining a known element (another insulating tape) to a known device (Sato-Kodama-Takemura battery), to prevent short-circuiting.

G. Claim 19

1. [19.A] “wherein a first location of a top surface of the positive lead is provided with a first insulating glue layer”

266. Element [19.A] is identical to Element [10.A], except that [19.A] further recites the language “a first location of.” *Compare* Element [10.A] “wherein a top surface of the positive lead is provided with a first insulating glue layer” *with* Element [19.A] “wherein a first location of a top surface of the positive lead is provided with a first insulating glue layer.” A POSA would have understood that the recited language “a first location of” does not patentably distinguish Element [19.A] from [10.A] because it merely identifies that the insulating glue layer is applied to some portion of the top surface of the positive lead, which is already encompassed by Element [10.A]. Thus, Element [19.A] does not impose any additional structural or functional limitation beyond providing the insulating glue layer on the top surface itself. Accordingly, Sato-Kodama-Takemura-Kobayashi discloses [19.A] for the same reasons as discussed with respect to [10.A]. Section IX.K.1.

2. [19.B] “a second location of a surface of the positive electrode active material layer corresponding to the second recess is pasted with a second insulating glue layer”

267. Element [19.B] is identical to Element [10.B], except that [19.B] further recites the language “a second location of.” *Compare* Element [10.B] “a surface of the positive electrode active material layer corresponding to the second recess is pasted with a second insulating glue layer” *with* Element [19.B] “a second location of a surface of the positive electrode active material layer corresponding to the second recess is pasted with a second insulating glue layer.” A POSA would have understood that the recited language “a second location of” does not patentably distinguish Element [19.B] from [10.B] because it merely identifies that the insulating glue layer is applied to some portion of the top surface of the positive electrode active material layer, which is already encompassed by Element [10.B]. Thus, Element [19.B] does not impose any additional structural or functional limitation beyond providing the insulating glue layer on the top surface itself. Accordingly, Sato-Kodama-Takemura-Kobayashi discloses [19.B] for the same reasons as discussed with respect to [10.B]. Section IX.K.2.

3. [19.C] “a third location of a surface of the positive current collector corresponding to the positive lead is covered with a third insulating glue layer.”

268. Element [19.C] is identical to claim 9, except that [19.C] further recites the language “a third location of.” *Compare* claim 9 “wherein a surface of

the positive current collector corresponding to the positive lead is covered with a third insulating glue layer” *with* Element [19.C] “a third location of a surface of the positive current collector corresponding to the positive lead is covered with a third insulating glue layer.” A POSA would have understood that the recited language “a third location of” does not patentably distinguish Element [19.C] from claim 9 because it merely identifies that the insulating glue layer is applied to some portion of the top surface of the positive current collector corresponding to the positive lead, which is already encompassed by claim 9. Thus, Element [19.C] does not impose any additional structural or functional limitation beyond providing the insulating glue layer on the top surface itself. Accordingly, Sato-Kodama-Takemura-Kobayashi discloses [19.C] for the same reasons as discussed with respect to claim 9. Section XI.F.

H. Claim 20 “wherein 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.”

269. Claim 20 is identical to Element [10.C]. *Compare* Element [10.C] “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” *with* Claim 20 “wherein 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.” Accordingly, Sato-Kodama-

Takemura-Kobayashi discloses claim 20 for the same reasons as discussed with respect to [10.C]. Section IX.K.3.

XII. OBJECTIVE INDICIA DO NOT SUPPORT PATENTABILITY.

270. 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.

271. 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 '330 patent. Should any alleged secondary indicia of nonobviousness be presented, I reserve the right to provide an opinion thereon.

XIII. 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 25 day of July, 2026, in Sidney, B.C. CANADA



Ulrich von Sacken, Ph.D.