UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHUHAI COSMX BATTERY CO., LTD.,
Petitioner

v.

NINGDE AMPEREX TECHNOLOGY LTD.,
Patent Owner

IPR2023-00585
Patent 11,329,352

DECLARATION OF JAMES L. KASCHMITTER, IN SUPPORT OF PATENT OWNER'S PRELIMINARY RESPONSE

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I. INTRODUCTION

1. I have been retained by Ningde Amperex Technology Ltd. ("ATL" or "Patent Owner") as an independent technical expert in this proceeding before the United States Patent and Trademark Office ("PTO") Patent Trial and Appeal Board ("PTAB") regarding U.S. Patent No. 11,329,352 (the "'352 Patent").

2. I understand that Zhuhai CosMX Battery Co., Ltd. ("Petitioner") filed a petition for Inter Partes Review of the '352 Patent ("Petition"), in which Petitioner asserts that:

- Claims 1-3 and 9-12 are obvious over Chinese Patent App. Pub. No. CN 104157914 A ("Wang" or "Ex. 1004") and Chinese Patent App. Pub. No. CN 101826609 A ("Deng" or "Ex. 1005") (Ground 1);
- Claims 1-3 and 9-12 are obvious over Wang and Chinese Patent Publication No. CN 202839841 U ("Zhou" or "Ex. 1013") (Ground 2);
- Claims 5-8 are obvious over Wang, Deng and U.S. Patent App. Pub. No. 2011/0159344 ("Kobayashi" or "Ex. 1006") (Ground 3);
- Claims 5-8 are obvious over Wang, Zhou and Kobayashi (Ground 4);
- Claim 11 is obvious over Wang, Deng and U.S. Patent App. Pub. No. 2013/0052499 A1 ("Hasegawa" or "Ex. 1007") (Ground 5); and
- Claim 11 is obvious over Wang, Zhou and Hasegawa (Ground 6)

3. I have been asked, for purposes of Patent Owner's Preliminary Response, to analyze and respond to Petitioner's assertion that claim 1 is obvious over Wang and Deng (Ground 1), and that claim 1 is obvious over Wang and Zhou (Ground 2). I reserve the right to analyze and respond to other alleged patentability challenges if this proceeding is instituted.

4. As explained below, in my opinion, the Petition fails to show that claim 1 of the '352 Patent is rendered obvious.

5. I am being compensated at my customary consulting rate of $600 per hour. My compensation is in no way contingent on the nature of my opinions or the outcome of this or any other proceeding. I have no other interest in this proceeding.

II. BASIS FOR OPINIONS

A. Qualifications

6. My qualifications and professional experience are described in my resume, a copy of which is provided with this Declaration as Ex. 2002. Also provided with this Declaration as Ex. 2003 is a list of my papers and presentations. The following is a summary of my qualifications and professional experience.

7. I am a consultant, engineer, inventor, and entrepreneur with over 30 years of experience with energy storage and generation, including theoretical principles, manufacturing methods, battery testing, packaging, application engineering, economics, and development of requirements and specifications for

lithium-ion batteries. I received a B.S. in Physics from the University of Utah in 1972, and an M.S.E.E. from Stanford University in 1976.

8. I have held various senior and managerial engineer positions in industry, academia, and federal laboratories, including at Berkeley Scientific Labs, Elxsi Corporation, nChip Corporation, and the Lawrence Livermore National Laboratory. During almost a decade at the U.S. Department of Energy's Lawrence Livermore National Laboratory, I was Project Leader for the Strategic Defense Initiative (President Reagan's "Star Wars" project) LLNL Advanced Power Group and Lead Engineer for the DOD/VHSIC laser pantography project, and developed and co-invented the carbon aerogel supercapacitor, as well as leading the development of Lithium-ion batteries for the SDIO and new materials for use in Lithium-ion batteries and fuel cells, among other projects.

9. I have also founded and co-founded several technology companies. At PolyStor Corporation, which I co-founded with a Technology Reinvestment Program grant issued under President Clinton, and where I was CEO and President for close to a decade, I was the lead inventor of a unique 18650-type lithium-ion battery cap and electrode design that provided improved safety, and led the development and commercial-scale manufacturing of various types of lithium-ion batteries, including a 18650 cylindrical model, an 8.5 mm prismatic model, a 4-6

mm lithium-ion-polymer model, and a high power automotive lithium-ion polymer model, which are shown below.

10. Furthermore, I led PolyStor's expansion and growth to become the only U.S. company manufacturing and selling lithium-ion batteries in large-scale commercial volumes at a capacity of 6 million cells per year. In 2000, I led Polystor's development of high-power large-format lithium-ion batteries for the U.S. Advanced Battery Consortium with Ford, GM, Chrysler, and AeroVironment. I also led PolyStor's commercialization, as the first company in the world to do so, of high-capacity Lithium Nickel Cobalt Oxide ($LiNiCoO_2$) cathodes for PolyStor's prismatic and polymer cells. In addition, I led PolyStor's commercial development and manufacturing of lithium-ion and lithium-ion-polymer batteries for Ericsson, Motorola, and other electronics companies.

11. At PowerStor Corporation, where I was CEO and President for three years, I led the commercialization of the Carbon Aerogel Supercapacitor for electrodes, with DARPA funding.

12. At UltraCell Corporation, where I was CEO and President for six years, I led the development and introduction of the world's smallest 25W micro-fuel cell for the U.S. Army and other entities. UltraCell's product was the only micro fuel cell at the time to complete and pass the rigorous testing requirements of the U.S. Army.

13. At SpectraPower, where I have been CEO for over twenty years, I lead the contract-based research and development of, and consulting on, Lithium-ion, Lithium-metal, and Nickel Zinc (NiZn) batteries, supercapacitors, and other types of energy storage devices. SpectraPower has the capabilities to design and build Lithium-ion pouch cells from raw materials to finished product, and test them, in a 4,000 ft^2 facility in Livermore, CA. Our customers include major companies, U.S. government agencies, startup companies and venture capitalists.

14. During my over thirty years of experience in the field of batteries and supercapacitors, including at the companies and research facilities described above, I have worked with almost every, if not all, aspects of battery manufacturing, including joining and welding methods between cells and within cells, such as the ultrasonic welding used in the '352 Patent and Wang, the resistance welding used in Deng, and laser welding.

15. In addition and in every year for the past five years, I have been invited to present a tutorial on "Li-Ion Cell Design and Manufacturing: Processes, Equipment and Quality Control" at one or more of the International Battery Seminar and Exhibit held annually in Florida and the Advanced Automotive Battery Conference held once per year in Mainz, Germany and once per year in San Diego, CA.

16. I have also published papers and given presentations on lithium-ion battery design and manufacturing and other aspects of the '352 Patent. Below are some of my exemplary papers and presentations on lithium-ion battery design and manufacturing and other aspects of the '352 Patent:

- "Validating Performance with Advanced Prototyping" James Kaschmitter, Steve Pierce, Aubert Demaray; Soteria Battery Innovation Group Meeting, Orlando, FL March 20, 2023.
- "Advanced Electrolytes for Extreme Fast Charging", April 17, 2023, Report to the U.S. Department of Energy; William Chueh, Mike Toney, Yi Cui, Johanna Nelson Weker, SLAC National Accelerator Laboratory, James Kaschmitter, SpectraPower LLC, Robert Kee, Colorado School of Mines.
- "Fundamentals and Manufacturing of Lithium Rechargeable Batteries", 1st Li-Ion-Solid Electrolyte & Lithium Metal (Liquid &

Solid Electrolyte) Rechargeable Cell Manufacturing Seminar, August 19-20, 2019.

- "Ultra-High Temperature Li-ion Battery", J. Kaschmitter and Victor Koch, 35th Annual International Battery Seminar & Exhibit March 26-29, 2018 Fort Lauderdale, FL.
- "Thin Film Solid State Li Metal Battery with High Energy Density and Cycle Life", E. Demaray, J. Kaschmitter and P. Khoklov, NASA Aerospace Battery Workshop 2016.
- "High Speed Li Polymer Battery Manufacturing and R&D Foundry Services", The 29th International Battery Seminar & Exhibit, March 12 - 15, 2012, Fort Lauderdale, Florida.
- "Cycle Life Testing of Lithium-Ion Batteries for Small Satellite LEO Space Missions", S.T. Mayer, J. H. Feikert and J. L. Kaschmitter, AIAA Conference on Small Satellites, Sept 13-16, 1993, Utah State University, Logan, UT. LLNL Preprint # UCRL-JC 114996.

17. I am also a named inventor or co-inventor on numerous patents relating to batteries and other aspects of the '352 Patent. Below are some exemplary patents on which I am a named inventor or co-inventor:

- US 5,402,306 Aquagel Electrode Separator for Use in Batteries and Supercapacitors Mar 28, 1995.

- US 5,336,274 Method for Forming a Cell Separator for Use in Bipolar-Stack Energy Storage Devices Aug 9, 1994.
- US 5,393,619 Cell Separator for Use in Bipolar-Stack Energy Storage Devices Feb 28, 1995.
- US 5,402,306 Aquagel Electrode Separator for Use in Batteries and Supercapacitors.
- US 5,609,972 Cell Cap Assembly having Frangible Tab Disconnect Mechanism.
- US 9,673,478 Multi-Layer Coatings For Bipolar Rechargeable Batteries With Enhanced Terminal Voltage, June 6, 2017.
- US 10,818,909 B2 "Energy Storage Device with a First Metal Layer Formed from a Precursor Layer upon Charge and Diffused into a Cathode during Discharge" October 27, 2020.

B. Materials Considered

18. The opinions contained in this Declaration are based on the documents I reviewed, as well as my education, years of professional experience, and knowledge. In forming my opinions expressed in this Declaration, I further reviewed the Petition, all exhibits or other material cited therein, and any additional exhibits or other material cited in this declaration.

19. This Declaration presents the opinions I have formed at the present time, and I reserve the right to revise, supplement, or amend my opinions stated in this Declaration based on any new information that I may be asked to review.

III. LEGAL STANDARDS

20. In this section, I describe my understanding of certain legal standards. I have been informed of these legal standards by Patent Owner's legal counsel. I am not an attorney and I am relying only on instructions from Patent Owner's legal counsel for these legal standards.

A. Claim Construction

21. My opinions concern what I believe a person of ordinary skill in the art ("POSITA") would have understood the meaning of certain claim terms to be based on the patent documents.

22. I have been informed that assessing the validity of a patent claim requires a two-step analysis. The first step involves the proper interpretation or construction of the claim language in order to determine its scope and meaning. The second step requires comparing the claim, as properly construed, to the alleged prior art to determine whether the limitations of the claim are met by the prior art.

23. My methodology for determining the meaning of claim phrases was first to study the patent carefully. In particular, I studied the claims themselves, followed by the background, detailed specification, figures, and other patent content.

Next, I reviewed the prosecution history looking for any clarifications or limitations that might be attached to claim terms. In some circumstances, I looked at other documents, such as references applied by the patent office.

24. I understand that in an *inter partes* review, claim terms are to be given their ordinary and customary meaning as understood by a person of ordinary skill in the art in the context of the entire disclosure at the time of the invention. I understand that one must be careful not to read a specific embodiment appearing in the written description into the claim if the claim language is broader than the embodiment. I further understand that any special definition for a claim term must be set forth with reasonable clarity, deliberateness, and precision.

25. I have been informed that this standard is the same as that used in United States district courts, in which claim terms are given their ordinary and customary meaning as would be understood by a person of ordinary skill in the art at the time of the invention having taken into consideration the language of the claims, the specification, and the prosecution history of record under the *Phillips* claim construction standard.

B. Prior Art Status

26. I understand that the "priority date" of a patent is the date on which it is filed, or the date on which an earlier-filed patent application is filed if the patentee claims the benefit of priority to that earlier-filed patent application. I understand that

a particular claim is entitled to claim the priority date of an earlier-filed application if the earlier-filed application provides written description of the subject matter of that particular claim.

27. I understand that a U.S. or foreign patent or patent application qualifies as prior art to an asserted patent if the date of issuance or publication of the patent or publication is prior to the priority date of the challenged patent.

28. I understand that a printed publication, such as an article published in a magazine or trade publication, qualifies as prior art to the challenged patent if the date of publication is prior to the priority date of the asserted patent.

29. I understand that to qualify as prior art, a reference must contain an enabling disclosure that allows one of ordinary skill to practice the reference's disclosure without undue experimentation.

C. Obviousness

30. I understand that a claimed invention is not patentable if the claimed invention would have been obvious to a person of ordinary skill in the field of the invention at the time of the patent claim's effective filing date.

31. I have been informed and understand that the obviousness analysis requires evaluating the claim language as a whole, including comparing each and every limitation of the properly construed claim language to the prior art.

32. I understand that a person of ordinary skill in the art provides a reference point from which the prior art and claimed invention should be viewed. This reference point prevents one from using his or her own insight or hindsight in deciding whether a claim is obvious.

33. I understand that in order to show obviousness based on a single reference or a combination of references, a particular motivation to modify the reference or combine the teachings in the references, and a reasonable expectation of success must be shown.

34. I understand that the obviousness inquiry includes consideration of various factors, such as the scope and content of the prior art, the differences between the prior art and the claims at issue, the knowledge of a person of ordinary skill in the pertinent art at the time of invention, and any objective factors indicating non-obviousness.

35. I am informed that objective factors indicating non-obviousness, also known as secondary considerations, may include (1) a long felt but unmet need in the prior art that was satisfied by the alleged invention of the patent; (2) commercial success or lack of commercial success of processes covered by the patent; (3) unexpected results achieved by the alleged invention; (4) praise of the alleged invention by others skilled in the art; (5) taking of licenses under the patent by others; and (6) deliberate copying of the alleged invention. I also understand that there must

be a relationship or nexus between any such secondary indicia and the alleged invention.

36. I understand that in order to rely on a reference for obviousness, the reference must be analogous art. I also understand that to be analogous art, the reference must be either (1) from the same field of endeavor as the claimed subject matter, regardless of the problem addressed, or (2) if not in the same field of endeavor, reasonably pertinent to the particular problem with which the inventor is involved. I am also familiar with the premise that for a reference to be reasonably pertinent, it must have logically commended itself to an inventor's attention at the time of invention.

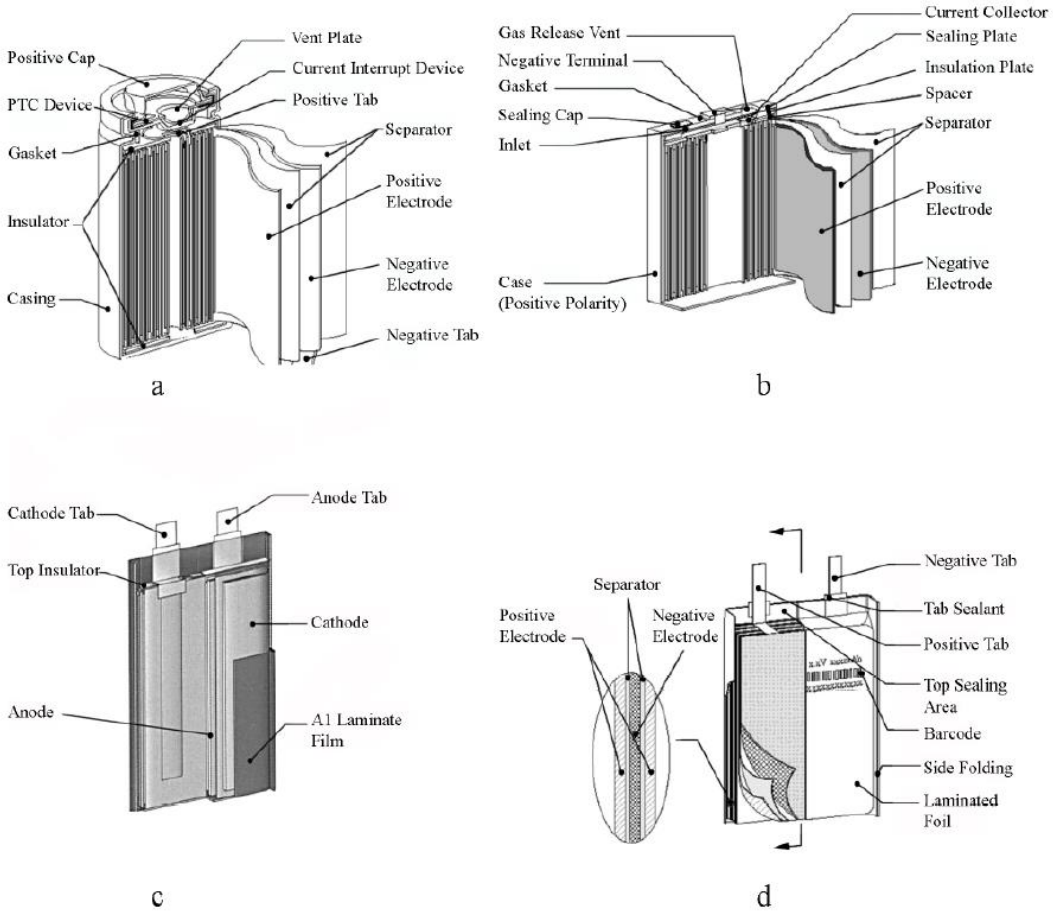
IV. TECHNOLOGY OVERVIEW

A. Secondary Battery Types and Manufacturing Considerations

37. Secondary or rechargeable batteries can be generally classified into five types: lead-acid batteries, alkaline batteries (including nickel-iron, nickel-cadmium, nickel-hydrogen, nickel-zinc, and nickel-metal-hydride batteries, and rechargeable alkaline batteries), lithium batteries, sodium batteries, and flow batteries. *See, e.g.,* Ex. 2004 at 2-6. While each battery cell in these different types of secondary batteries operates under the same general principle of converting ion transfer energy (chemical energy) into electron transfer energy (electrical energy) through an anode, cathode, and electrolyte, they employ different materials, structures, and designs. *Id.*

38. Among the different types of secondary batteries, the lithium-ion battery has received a great deal of attention because it provides one of the highest energy densities of all available systems. Ex. 2005 at 1. In particular, lithium is the lightest metal and, thus, produces lighter batteries. Ex. 2004 at 4. Lithium also has a high specific capacity and specific energy. *Id.*

39. Lithium-ion batteries can have different cell structures or "formats," such as the cylindrical (a), prismatic (b), pouch (c), and stacked (d) formats shown below, each of which may employ different types of internal welding mechanisms.



Ex. 2007, Fig. 3.

40. The lithium-ion battery cell formats shown above were typical of small battery cells used in portable power applications at the time of the priority date of the ’352 Patent. These cell formats typically provided less than about 5 A·h in capacity. These lithium-ion battery cell formats employed very thin electrode current collectors with thicknesses that ranged from around 9 microns to 15 microns. *See, e.g.*, Ex. 2006 at 236-37 (describing exemplary “standard current collector thicknesses of 9 μm for the anode Cu foil and 15 μm for the cathode Al foil”).

41. For applications and battery types that required higher capacities, “large prismatic” cell formats were often used, particularly for lower energy density chemistries such as nickel-based alkaline cells, such as the nickel metal hydride (NiMH) cell, an example of which is shown below.

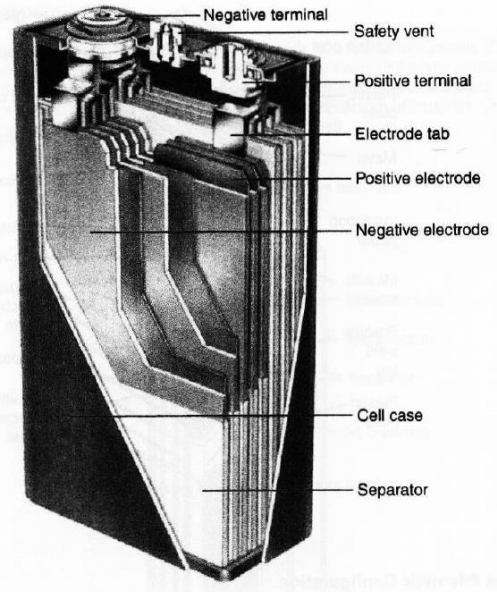


FIGURE 22.10 Cutaway view of a prismatic NiMH cell.

Ex. 2008, Fig. 22.10.

42. At around the priority date of the ’352 Patent, these types of large prismatic cell formats used larger and thicker flat metal plate electrodes than lithium-ion cells with thicknesses that ranged from about 700 microns to multiple millimeters.

43. Each of these types of batteries requires various tab junctions, including electrode-to-tab and tab-to-tab joining or welding, which is an important manufacturing consideration for lithium-ion batteries. For example, a secondary lithium-ion battery pack for electric vehicles typically consists of a large number of battery cells, sometimes several hundreds, even thousands, to meet desired power and capacity needs. Ex. 2005 at 1.Several cells are usually joined together to form a module, and in typical implementations, there are ten or more modules in a battery pack. *Id.* Meanwhile, each cell within a lithium-ion battery requires joining between at least one electrode tab and one electrode. As a result, a significant amount of joining, such as welding, both internally within a cell between electrode tabs and electrodes (“internal welding”), and externally between different cells (“external welding”), is needed to deliver electricity in a battery pack. *Id.* A person of ordinary skill in the art would understand it is not a trivial task to carry out high volume production welding for such large numbers of battery cells, particularly for lithium-ion battery cells, due to the difficulty with welding multiple layers of thin, highly

conductive and dissimilar materials in lithium-ion battery cells as explained further below. *Id.*

44. There are different types of joining methods and techniques for internal welding, including resistance welding, laser welding, ultrasonic welding, and mechanical joining. *Id*. at 2. However, a person of ordinary skill would understand that joining methods are very particular to battery types and formats and not all joining methods can be used in each battery type or format.

45. One joining method is resistance welding. Resistance welding relies on the electrical resistance at the metal interface to cause a localized heating and fusion of materials. Ex. 2005 at 2. A person of ordinary skill in the art would understand that resistance welding is not used and cannot be used for internal welding of the thin current collectors in certain battery types, such as lithium-ion batteries, which rely on highly conductive materials such as aluminum and copper for their electrode current collectors and tabs because aluminum and copper have high thermal and electrical conductivities and low melting points. *Id.*

46. In addition, lithium-ion batteries have very thin current collectors which, when combined with the effect of the high thermal and electrical conductivities of the aluminum and copper materials that comprise them, would be easily burned, melted, and/or damaged by the high temperature heat employed in resistance welding. *See, e.g.,* Ex. 2006 at 236-37 (describing exemplary "standard

current collector thicknesses of 9 μm for the anode Cu foil and 15 μm for the cathode Al foil" at around the priority date of the '352 Patent). In contrast, resistance welding is known to be a good internal welding method to use on flat metal plate type batteries such as nickel-metal-hydride or nickel zinc batteries, as these types of batteries employ much thicker and sturdier electrode plates, and nickel is more thermally resistive due to its high melting point. Ex. 2005 at 2.

47. Ultrasonic welding, on the other hand, is widely used in internal welding of the thin current collectors of lithium-ion batteries. *Id.* at 3. Ultrasonic welding uses a high frequency of ultrasonic energy to produce oscillating shears to create solid-state bonds between two sheets clamped under pressure. *Id.* The lateral forces generated at high frequency produce an atomic bond between metal interfaces at elevated but relatively low temperatures. *Id.* Ultrasonic welding is a preferred method for internal welding in lithium-ion batteries as it works well for thin copper and aluminum current collectors, dissimilar materials and multiple thin layers. *Id.* Ultrasonic welding is also preferable for lithium-ion batteries due to its low operating temperature and good welding performance for aluminum, copper, and other highly conductive materials used in lithium-ion batteries. *Id*. In contrast, ultrasonic welding is generally not suitable for internal welding in flat metal plate type batteries such as nickel-based batteries, because such batteries employ thick

nickel electrode plates requiring stronger, high temperature welding such as resistance welding.

48. Another consideration in lithium-ion battery manufacturing is the method of coating an active layer on a current collector of an electrode while creating bare recessed areas, for example, for electrical connections to electrode tabs. One of the oldest and most widely used coating and recess-creating methods in lithium-ion batteries is "patch" or "gap" coating. In lithium-ion battery "patch" or "gap" coating, the active material layer of an electrode is coated on the current collector of the electrode while leaving certain uncoated "island" areas *extending across the entire width of the current collector* to create recesses that permit, for example, connections between the current collector and electrode tabs.

49. Creating recessed areas only in specific areas of the active material of a lithium-ion battery that do not extend across the entire width of the current collector requires a method such as laser ablation, which involves continuously coating an active material layer on a current collector by any conventional coating method, then selectively etching away or removing active material in a select area of the active material layer by irradiating that area with a pulsed laser beam. Because laser ablation relies on pulsed laser beams, laser ablation enables the removal of active material in select areas of the active layer, such as on one side or edge of the electrode. However, because laser ablation employs high temperature pulsed laser

beams to remove active material, it can create defects such as dislocations and burrs in the areas treated with the laser beams, particularly when scanning the laser beams to create the island areas, potentially resulting in beam focal length fluctuations and deviations. *See, e.g.*, Ex. 1001, 1:27-34[1].

B. The '352 Patent

50. The '352 Patent discloses secondary batteries, such as wound lithium-ion batteries, that solve problems in the prior art caused by burrs generated from grooves created by laser ablation or laser cleaning. Ex. 1001, 2:26-40, 3:50-65, 7:58-8:3, 13:43-50, 14:58-67. In particular, the '352 Patent discloses:

> A secondary battery, comprising:
> a first electrode tab;
> a first electrode plate, comprising:
> a first current collector; and
> a first active substance, disposed on a first surface of the first current collector and a second surface of the first current collector, wherein the second surface is opposite to the first surface;
> a first electrode tab receiving groove, defined by an exposed portion of the first surface of the first current collector and the first active

[1] The '352 Patent refers to a "laser cleaning" method of creating grooves, which a person of ordinary skill in the art would understand to be referring to laser ablation. Ex. 1001 at 10:64-11:30, Ex. 2001, ¶ 49.

substance on a periphery of the first electrode tab receiving groove, the first electrode tab receiving groove receiving the first electrode tab, wherein the first electrode tab is electrically connected with the first current collector through the first electrode tab receiving groove;

a first recess that is opposite to the first electrode tab receiving groove, defined by a corresponding portion of the second surface of the first current collector and the first active substance on a periphery of the first recess;

a first electrode plate notch disposed on a side edge of the first electrode tab receiving groove and extending through the second surface and the first surface of the first current collector; and

the first electrode tab receiving groove is formed by the first current collector and at least two first active substance walls;

wherein the secondary battery is a wound-type secondary battery.

Id., Claim 1.

51. The ’352 Patent explains that in prior art batteries:

[T]he laser cleaned groove on the electrode plate has an overheated perforation or a burned hole on the edge due to focal length fluctuation and deviation, such that a plenty of burrs are formed on a current collector on the edge of the groove; if the electrode plate with burrs is directly manufactured into a cell without processing, then the burrs will pierce the separator to cause internal short circuit, a fire disaster and other severe potential safety hazards.

Ex. 1001, 1:27-34.

52. The ’352 Patent then explains that the use of the claimed first electrode plate notch removes the burrs formed by laser ablation thereby preventing an internal short circuit and thus improving the safety performance of the battery:

> In the secondary battery according to the present invention, the anode electrode tab is received in the anode electrode tab receiving groove, and the cathode electrode tab is received in the cathode electrode tab receiving groove, thus effectively improving the energy density of the secondary battery; the anode electrode plate die-cut notch can remove the burrs formed on the current collector on the edge part of the anode electrode tab receiving groove during formation, and the cathode electrode plate die-cut notch can effectively remove the burrs formed on the current collector on the edge part of the cathode electrode tab receiving groove during formation, thus effectively preventing the secondary battery from generating internal short circuit, and improving the safety performance of the secondary battery while ensuring a high energy density.

Ex. 1001, 2:26-40; *see also* 3:50-65, 7:58-8:3, 13:43-50, 14:58-67.

V. LEVEL OF ORDINARY SKILL IN THE ART

53. Each of the arguments below should be considered from the standpoint of a person of ordinary skill in the art in the field of the ’352 Patent.

54. I understand that Petitioner provides the following definition of a person of ordinary skill in the art:

> A person of ordinary skill in the art ("POSITA") at the time of the alleged invention, August 31, 2015, would have had a bachelor's degree from an accredited institution in a discipline relating to lithium-ion secondary batteries, including but not limited to electrical engineering, mechanical engineering, physics, materials science, chemistry, or chemical engineering, as well as three or more years of academic or industry experience in the field of batteries, including battery design. Ex. 1002, ¶¶39-41.

Pet. at 14.

55. For purposes of this declaration in support of Patent Owner's Preliminary Response, I offer no independent opinion of the level of ordinary skill in the art but have adopted the definition proposed by Petitioner. I reserve the right to further address the level of ordinary skill in the art if this proceeding is instituted.

VI. THE BOARD SHOULD NOT INSTITUTE INTER PARTES REVIEW

56. I understand that in order for an *inter partes* review to be instituted, the Petition must establish that there is a reasonable likelihood that at least one challenged claim is unpatentable. For at least the reasons I explain below, it is my opinion that the Petition fails to do so.

A. Ground 1: Wang and Deng Do Not Render Obvious Claims 1-3 and 9-12

57. Petitioner contends that Wang and Deng render obvious claims 1-3 and 9-12 of the '352 Patent. These claims recite:

1. A secondary battery, comprising:

a first electrode tab;

a first electrode plate, comprising:

a first current collector; and

a first active substance, disposed on a first surface of the first current collector and a second surface of the first current collector, wherein the second surface is opposite to the first surface;

a first electrode tab receiving groove, defined by an exposed portion of the first surface of the first current collector and the first active substance on a periphery of the first electrode tab receiving groove, the first electrode tab receiving groove receiving the first electrode tab, wherein the first electrode tab is electrically connected with the first current collector through the first electrode tab receiving groove;

a first recess that is opposite to the first electrode tab receiving groove, defined by a corresponding portion of the second surface of the first current collector and the first active substance on a periphery of the first recess;

a first electrode plate notch disposed on a side edge of the first electrode tab receiving groove and extending through the second surface and the first surface of the first current collector; and

the first electrode tab receiving groove is formed by the first current collector and at least two first active substance walls;

wherein the secondary battery is a wound-type secondary battery.

2. The secondary battery according to claim 1, further comprising:

a second electrode tab;

a second electrode plate, comprising:

a second current collector; and

a second active substance, disposed on a surface of the second current collector;

a second electrode tab receiving groove, configured to receive the second electrode tab, wherein the second electrode tab is electrically connected with the second current collector through the second electrode tab receiving groove; and

a second electrode plate notch disposed on a side edge of the second electrode tab receiving groove and extending through the surface of the second current collector.

3. The secondary battery according to claim 2, wherein:

the first electrode plate is an anode electrode plate;

the first current collector is an anode current collector;

the first active substance is an anode active substance;

the first electrode tab is an anode electrode tab;

the first electrode tab receiving groove is an anode electrode tab receiving groove;

the first recess is an anode recess;

the first electrode plate notch is an anode electrode plate notch;

the second electrode plate is a cathode electrode plate;

the second current collector is a cathode current collector;

the second active substance is a cathode active substance;

the second electrode tab is a cathode electrode tab;

the second electrode tab receiving groove is a cathode electrode tab receiving groove; and

the second electrode plate notch is a cathode electrode plate notch.

9. The secondary battery according to claim 1, wherein:

the first electrode tab receiving groove is defined by the first active substance and extends to the first surface of the first current collector; and

the first electrode plate notch extends through the first current collector from the first surface of the first current collector.

10. The secondary battery according to claim 2, wherein:

the second electrode tab receiving groove is defined in the second active substance and extends to the surface of the second current collector; and

the second electrode plate notch extends through the second current collector from the surface of the second current collector.

11. The secondary battery according to claim 1, wherein a whole of the first electrode tab is parallel with the first surface of the first current collector.

12. The secondary battery according to claim 1, wherein a bottom of the first electrode plate notch is located between the first active substance disposed on two opposite sides of the first electrode tab receiving groove in the length direction of the first electrode plate.

1. The Petition Fails to Show That Wang and Deng Render Obvious Claim 1

a. Deng's "Notch 2" Is Not "A First Electrode Tab Receiving Groove" or "A First Electrode Plate Notch"

58. I understand that Petitioner acknowledges that Wang does not expressly disclose the claimed first electrode plate notch and relies on Deng as teaching this limitation. Pet. at 28. I understand that Petitioner and Petitioner's expert Dr. von Sacken claim that Deng's "notch 2" is functionally equivalent to the claimed "first electrode plate notch." Pet. at 28-30; Ex. 1002, 73-75. Deng's notch 2, however, is not "disposed on a side edge of the first electrode tab receiving groove" that "***receiv[es]*** the first electrode tab," and thus, discloses neither the "first electrode plate notch" nor the "first electrode tab receiving groove" of claim 1. Ex. 1001, Claim 1.

59. Claim 1 recites that the "first electrode tab receiving groove" is "defined by an exposed portion of the first surface of the first current collector and the first active substance on a periphery of the first electrode tab receiving groove" and "the first electrode tab receiving groove receiving the first electrode tab." Ex. 1001, claim 1. Further, claim 1 requires that "the first electrode tab is electrically connected with the first current collector through the first electrode tab receiving groove." *Id*. Additionally, claim 1 requires that the claimed first electrode plate notch is "disposed on a side edge of the first electrode tab receiving groove," which is

"defined by an exposed portion of the first surface of the first current collector and the first active substance on a periphery of the first electrode tab receiving groove." *Id*. See claim 1 of the '352 Patent, reproduced below:

> 1. A secondary battery, comprising:
>
> a first electrode tab;
>
> a first electrode plate, comprising:
>
> a first current collector; and
>
> a first active substance, disposed on a first surface of the first current collector and a second surface of the first current collector, wherein the second surface is opposite to the first surface;
>
> a first electrode tab receiving groove, defined by an exposed portion of the first surface of the first current collector and the first active substance on a periphery of the first electrode tab receiving groove, the first electrode tab receiving groove receiving the first electrode tab, wherein the first electrode tab is electrically connected with the first current collector through the first electrode tab receiving groove;
>
> a first recess that is opposite to the first electrode tab receiving groove, defined by a corresponding portion of the second surface of the first current collector and the first active substance on a periphery of the first recess;

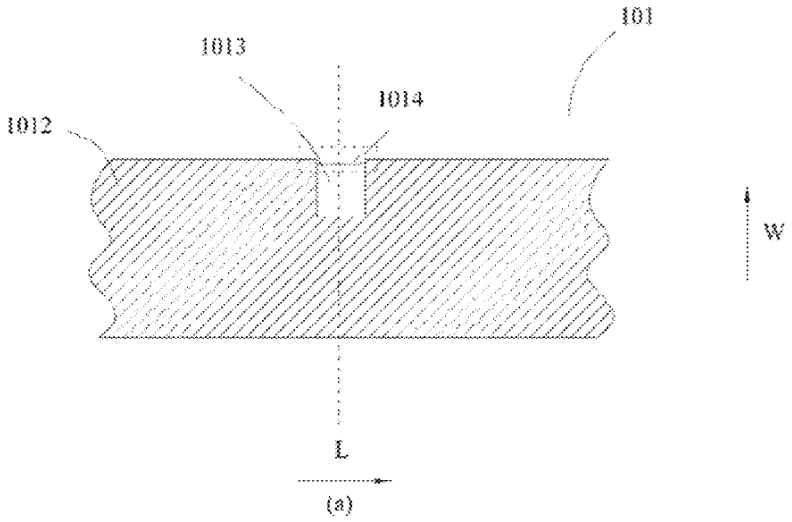
a first electrode plate notch disposed on a side edge of the first electrode tab receiving groove and extending through the second surface and the first surface of the first current collector; and

the first electrode tab receiving groove is formed by the first current collector and at least two first active substance walls;

wherein the secondary battery is a wound-type secondary battery.

Ex. 1001, Claim 1.

60. By way of example, I reproduce Fig. 5(a) of the ’352 Patent which illustrates an exemplary top-down view of the claimed first electrode tab receiving groove annotated as 1013 before it receives the first electrode tab, and before the first electrode tab is electrically connected with the first current collector through the first electrode tab receiving groove.



61. Figs. 2(a) and 2(b) of the ’352 Patent, which I reproduce below, illustrate an exemplary cross-sectional view and an exemplary top-down view, respectively, of the claimed first electrode tab receiving groove 1013 after receiving the claimed first electrode tab annotated as 102, and after the first electrode tab 102 is electrically connected to the first current collector annotated as 1011. As is illustrated, first electrode tab 102 “is received in the anode electrode tab receiving groove 1013” (Ex. 1001, 6:13-22):

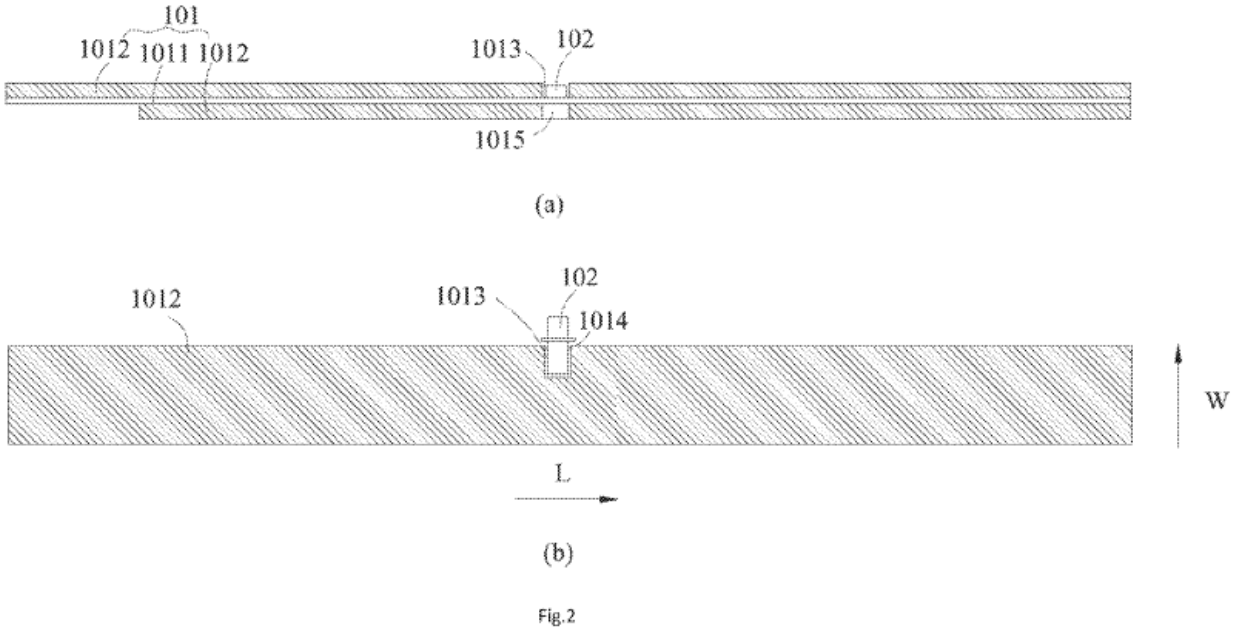


Fig.2

62. Unlike claim 1, which requires that the claimed first electrode plate notch be “disposed on a side edge of the first electrode tab receiving groove” that “***receiv[es] the first electrode tab***,” Deng explains that ***its*** notch 2 is positioned in a “to-be-welded area” on the electrode and that the notch 2 is in “a direction

perpendicular to a welding direction." Ex. 1005, [0004]. While Deng does not provide any details as to whether the "to-be-welded area" is necessarily on the current collector, a person of ordinary skill in the art would understand that by forming the notch in a direction perpendicular to the welding direction, Deng does not disclose that its notch 2 receives the tab. Specifically, Deng recites:

> The technical solution provided by the present invention is as follows: before welding, at least one notch is made at a to-be-welded area on the tab or the electrode, the notch being ***in a direction perpendicular to a welding direction***; then the electrode and the tab are connected by welding using a conventional welding method so that they are connected to form a whole (the electrode and the tab are welded together into a member called current collector)

Ex. 1005, [0004]. [2]

> FIG. 1a shows a notch configuration, and FIG. 1b shows an after-welding state. Before welding, a notch 2 is made at a to-be-welded area on an electrode 3, the notch being ***in a direction perpendicular to a welding direction (the direction is indicated by the dotted line in the drawing)***; then a tab 1 and the electrode 3 are welded to form a current collector 4.

Id. [0014].

[2] All emphasis in this Declaration is added.

63. Below are Deng's Figure 1a showing Deng's electrode 3 before welding, and Figure 1b showing Deng's electrode 3 after welding. Ex. 1005, Figs. 1a-1b, [0014]. As can be seen from Figure 1b (and in view of Petitioner's interpretation that Figures 1a and 1b of Deng illustrate a **top** view (Pet. at 29-31)), the tab 1 of Deng is, at best, being welded to an area *on the top of* and *overlapping* with the electrode 3 and is not "received" in notch 2, or any groove where the notch 2 is disposed, as required by claim 1.

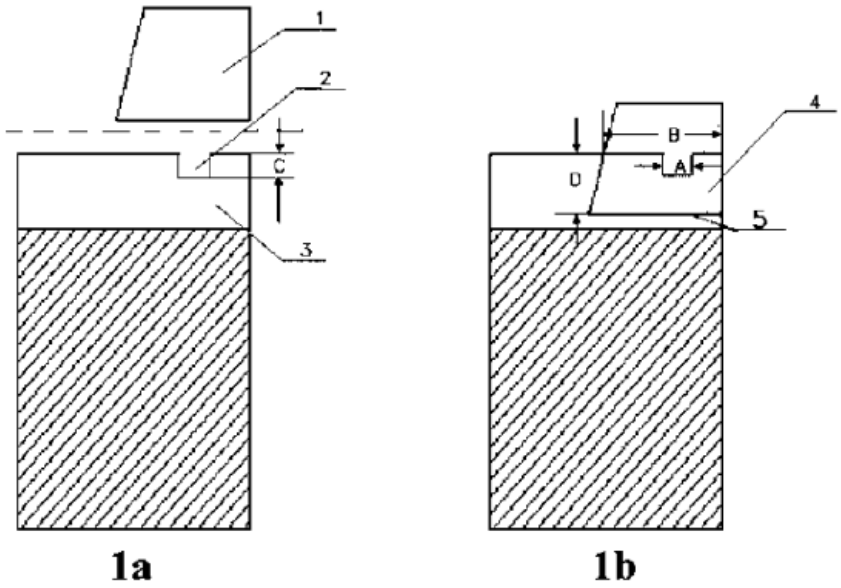


FIG. 1

Ex. 1005, Figs. 1a-1b.

64. In addition, neither Deng nor the Petition clarify whether notch 2 is "disposed on a side edge of the first electrode tab receiving groove" that is defined by "a first active substance" as required in claim 1. Ex. 1001, Claim 1. In fact, I do

not see any evidence in Deng that notch 2 is "disposed on a side edge of the first electrode tab receiving groove" that is defined by "the first active substance on a periphery of the first electrode tab receiving groove." *Id.*

65. Petitioner expressly acknowledges that Deng's notch 2 is in a "'to-be-welded area' of the electrode before the tab is welded to the electrode" but is silent as to whether notch 2 or any groove where the notch is disposed as recited in claim 1 actually receives a tab:

> As discussed above in Section VII.A.2, Deng discloses making a notch through the edge of an electrode plate in a "to-be-welded area" of the electrode before the tab is welded to the electrode. Ex. 1005, ¶¶[0004], [0014]. Deng discloses doing so because welding the electrode tab to the electrode "results in deformation caused by heat and stress accumulation," which "will lead to serious warping of the tab or wrinkling of the welding area of the electrode, and such deformation is detrimental to electrical performance of the battery." Id., ¶[0002]. Deng's notch "changes the structure of a welding area of the tab" on the electrode so that "the welding area is discontinuous, and heat or deformation is also discontinuous and stops at the notch rather than accumulates into the next section. As a result, accumulation of heat in the welding is reduced, and accumulation of warping is also reduced." Id., ¶[0007]. This "enables reduction of warping of the current collector to a very large extent, demonstrates good results, and improves outcome of battery cell assembly, thereby enhancing electrical performance of batteries." Id.; Ex. 1002, ¶73.

Ex. 1004, 28-29.

66. Moreover, Deng discloses that a plurality of notches is preferred. Ex. 1005, [0006]. A person of ordinary skill in the art would have understood that a tab could not be received by a plurality of notches. Instead, a person of ordinary skill in the art would have understood that Deng merely discloses the use of notches in a perpendicular direction to prevent the spreading and accumulation of heat into the area surrounding the welding area, not to receive a tab.

67. As a result, notch 2 of Deng cannot be a "first electrode plate notch" that is "disposed on a side edge of the first electrode tab receiving groove" that "receiv[es] the first electrode tab." Ex. 1001, Claim 1.

68. Because Deng does not disclose a "first electrode tab receiving groove" that "receiv[es] the first electrode tab," it cannot and does not disclose "first electrode plate notch" that is "disposed on a side edge of" such a groove. *Id*. That is, without the "first electrode tab receiving groove," Deng cannot show a "first electrode plate notch" that is "disposed on a side edge of the first electrode tab receiving groove." *Id.*

b. A Person of Ordinary Skill in the Art Would Not Have Combined Wang and Deng

69. Petitioner explains that Deng's notch 2 is provided to reduce deformation and warping caused by heat and stress accumulation from the process

of resistance welding Deng's electrode tab to Deng's electrode using resistance welding. Pet. at 28-29. Specifically, Petitioner states:

> As discussed above in Section VII.A.2, Deng discloses making a notch through the edge of an electrode plate in a "to-be-welded area" of the electrode before the tab is welded to the electrode. Ex. 1005, ¶¶[0004], [0014]. Deng discloses doing so because welding the electrode tab to the electrode "results in deformation caused by heat and stress accumulation," which "will lead to serious warping of the tab or wrinkling of the welding area of the electrode, and such deformation is detrimental to electrical performance of the battery." Id., ¶[0002]. Deng's notch "changes the structure of a welding area of the tab" on the electrode so that "the welding area is discontinuous, and heat or deformation is also discontinuous and stops at the notch rather than accumulates into the next section. As a result, accumulation of heat in the welding is reduced, and accumulation of warping is also reduced." Id., ¶[0007]. This "enables reduction of warping of the current collector to a very large extent, demonstrates good results, and improves outcome of battery cell assembly, thereby enhancing electrical performance of batteries." Id.; Ex. 1002, ¶73.

Id.

70. Petitioner then asserts that a person of ordinary skill in the art would have been motivated to modify Wang's electrode with Deng's notch in view of the benefits provided by Deng's notch, such as reduction of heat accumulation and the resulting deformation and/or warping of the electrode to which the tab is welded:

> In view of Deng's stated benefits of its electrode notch, such as to reduce the accumulation of heat and the resulting deformation and/or warping of the electrode to which the tab is welded, a POSITA would have been motivated to modify Wang's negative electrode to include a notch on the current collector where the first (e.g., anode) electrode tab will be welded. Ex. 1002, ¶76.

Id. at 30.

71. As I explain further below, I disagree that a person of ordinary skill in the art would have been motivated to combine Wang's battery with Deng's notch 2 to arrive at the claimed secondary battery. At best, Wang discloses a lithium-ion battery that employs very thin, foil type aluminum or copper current collectors and thin electrode tabs (Ex. 1004, [0018]), whereas Deng discloses an unrelated ***flat metal plate type battery*** such as a nickel metal hydride, lead acid, or nickel zinc battery, that comprises thick electrode plates and large, heavy electrode tabs, as I explain below. A person of ordinary skill in the art would not have considered a flat metal plate type battery's technology when innovating with respect to a lithium-ion battery.

72. Next, Deng discloses the use of ***resistance welding*** for the purposes of welding a tab to a "to-be-welded area." Ex. 1004, [0002], [0014]. Specifically, Petitioner relies on Deng's method of reducing the accumulation of heat and

deformation and/or warping of the electrode resulting ***from resistance welding*** as its reason to combine Wang and Deng. Pet. at 30.

73. Wang, on the other hand, uses ultrasonic welding. In particular, Wang discloses that its cells, and tabs of the same electrode type, are welded by "ultrasound welding" which a person of ordinary skill in the art would have understood to be referring to ultrasonic welding. Ex. 1004, [0043], [0048], [0109]. And a person of ordinary skill in the art would have further understood that Wang's electrode tabs are also internally welded by ultrasonic welding, as this was, at the time of the priority date of the '352 Patent, and continues to be now, the industry standard for internal welding in lithium-ion batteries, due to the thin copper and aluminum current collectors used in lithium-ion batteries. *See supra* § IV.A.

74. A person of ordinary skill in the art would have understood that the ultrasonic welding method used by Wang would have ***no need for reducing heat accumulation***, unlike the resistance welding used by Deng. A person of ordinary skill in the art would not have used the resistance welding method disclosed in Deng in Wang's lithium-ion battery, and, thus, would not have used or relied on any methods of reducing problems from resistance welding such as heat accumulation and deformation and/or warping, when modifying Wang's lithium-ion battery, as I explain below. In fact and as I discuss *supra* § IV.A and below, use of resistance

welding in Wang would cause significant damage to Wang's current collector, rendering Wang's lithium-ion battery inoperable.

75. In addition, the comparatively deep notch that Petitioner proposes making in Wang is not something a person of ordinary skill in the art would make, because lithium-ion batteries employ very thin current collectors, and making such a deep notch in Wang's thin current collector would make it susceptible to damage and tearing. This deep notch could also cause inconsistent weld performance when using ultrasound for welding.

(i) **Deng is Not a Lithium-Ion Battery**

76. Deng's figures and disclosure indicate that Deng discloses a ***flat metal plate type battery*** such as a nickel metal hydride, lead acid, or nickel zinc battery, that employs stacked thick electrode plates and large, thick electrode tabs, which is completely different from lithium-ion batteries, which employ very thin, foil type aluminum or copper current collectors and thin electrode tabs. A person of ordinary skill in the art would not consider flat metal plate type batteries when designing a lithium-ion battery.

77. Deng discloses welding a large, and likely thick electrode tab (as needed for use with resistance welding) to its electrode to "form a current collector 4" as shown in reproduced Figures 1a and 1b of Deng below:

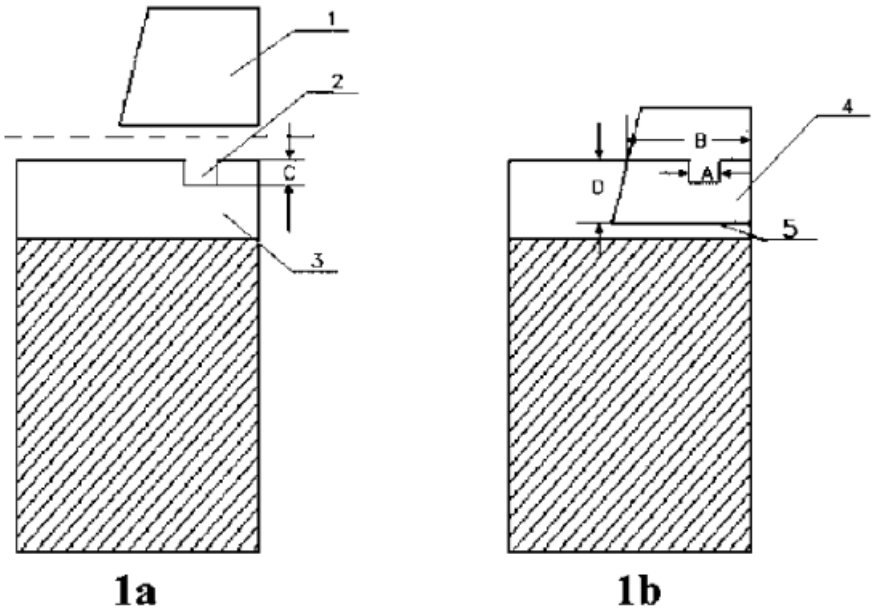


FIG. 1

Ex. 1005, Figs. 1a and 1b.

78. The relative sizes and dimensions of Deng's electrode 3 and electrode tab 1 indicate that Deng's battery is not a lithium-ion battery, but a flat metal plate type battery that employs thick metal electrode plates and thick electrode tabs, such as a nickel metal hydride battery. In addition, Deng's manner of welding a large electrode tab to an electrode in a direction perpendicular to the welding direction (Ex. 1001, Figs. 1a and 1b, [0004]) also indicates that Deng's battery is a flat metal plate type battery, as a person of ordinary skill in the art would not weld electrode tabs in lithium-ion batteries in such a manner. Furthermore, Deng's Figures 1a and 1b illustrate that Deng creates a relatively large notch 2, which a person of ordinary skill in the art would not do in a lithium-ion battery because such large notches would

weaken the fragile thin current collectors of a lithium-ion battery, which could then easily tear during subsequent manufacturing steps, substantially reducing production yields. Furthermore, a person of ordinary skill in the art would not use such large, thick electrode tabs in lithium-ion cells because they will reduce the energy density (Whr/kg) of the cell, reducing performance and making it less competitive.

79. A person of ordinary skill in the art would further understand that Deng discloses a flat metal plate type battery and not a lithium-ion battery because of Deng's reliance on resistance welding to internally weld its electrode tab to its electrode. Ex. 1001, [0002]. As discussed in further detail below, resistance welding is not an internal welding method that a person of ordinary skill in the art would use in lithium-ion batteries because resistance welding is not suitable to internally weld thin electrode tabs to the very thin copper or aluminum current collector foil layers in lithium-ion batteries. Instead, resistance welding would only be used for internal welding in a flat metal plate type battery such as a nickel metal hydride battery.

80. Finally, I understand that the assignee of Deng, Hunan Keba Automobile Power Battery Limited Liability Company, is a company that is involved in the design and production of nickel metal hydride batteries. *See* Ex. 2009 (indicating that Hunan Copower EV Battery Co, which I understand to be a subsidiary of Hunan Corun New Energy Group, the parent entity of Deng's assignee Hunan Keba Automobile Power Battery Limited Liability Company, "specializes in

the design and production of nickel-metal hydrogen technology[,] [b]attery components, batteries and hybrid power systems."). In addition to the specific disclosures recited above, the assignee's business focus further corroborates that the battery of Deng is not a lithium-ion battery.

81. It is therefore my opinion that a person of ordinary skill in the art would not have considered, let alone be motivated, to combine Wang, which relates to a lithium-ion battery, with Deng, which relates to a flat metal plate type battery.

(ii) **Deng's Heat Mitigation Technique is Not Reasonably Pertinent to Lithium-Ion Batteries**

82. Deng explains that welding between an electrode tab and an electrode is typically done by "electric resistance welding**"** which produces heat and stress accumulation that causes deformation and warping of the tab or wrinkling of the welding area of the electrode:

> Among components in a battery, current collector connection comprises connection between a tab and a center pin and connection between a tab and an electrode; the former typically uses riveting, welding, or a combination of both, and the latter typically uses ***electric resistance welding***. Currently, the whole welding area is continuous in the welding of the tab and the electrode. In the welding process, ***the accumulation of heat and stress cannot be eliminated***. Therefore, ***this welding method easily results in deformation caused by heat and stress accumulation***. ***The accumulation of the deformation will lead to serious warping of the tab or wrinkling of the welding area of the***

> ***electrode, and such deformation is detrimental to electrical performance of the battery***.

Ex. 1005, [0002].

83. Deng then explains that its notch is made at the welding area of the tab or electrode to reduce the accumulation of heat and warping, indicating that its battery also uses resistance welding, and that its notch is created to address the heat and warping problems that result from resistance welding. Ex. 1005, [0007]. Specifically, Deng discloses creating a notch to change the structure of the welding area such that the welding area will be discontinuous and heat will not spread and accumulate into the area surrounding the welding area, to address the heat and warping caused by resistance welding:

> In comparison with currently available connecting methods, the present invention changes the structure of a welding area of the tab or the electrode by ***making a notch at the welding area of the tab or the electrode, so that the welding area is discontinuous, and heat or deformation is also discontinuous and stops at the notch rather than accumulates into the next section***. ***As a result, accumulation of heat in the welding is reduced, and accumulation of warping is also reduced***. This enables reduction of warping of the current collector to a very large extent, demonstrates good results, and improves outcome of battery cell assembly, thereby enhancing electrical performance of batteries. In addition, this method is simple in this technique and delivers good operational performance.

Ex. 1005, [0007].

84. Because a flat metal plate type battery, such as the battery disclosed in Deng, has thick electrodes and thick electrode tabs, it requires a high energy, high heat-based welding technique such as resistance welding that can provide sufficiently high currents to weld the thick electrode plates and electrode tabs in such batteries. The high current from resistance welding in turn generates heat and stress, which accumulate in the welded area, and cause warping of the electrode tab or wrinkling of the welding area of the electrode. See, e.g., Ex. 1005, [0002]. Deng provides its notch 2 so that "the welding area is discontinuous, and heat or deformation is also discontinuous and stops at the notch rather than accumulate[] into the next section" and as a result, "accumulation of heat in the welding [area] is reduced, and accumulation of warping is also reduced." Ex. 1005, [0007].

85. On the other hand, as explained above, lithium-ion batteries such as the battery disclosed by Wang employ ultrasonic welding, which is a different and unrelated form of welding, for internal welding of electrode tabs to current collectors. Wang in particular discloses that its cells, and tabs of the same electrode type, are welded by "ultrasound welding" which a person of ordinary skill in the art would have understood to be referring to ultrasonic welding. Ex. 1004, [0043], [0048], [0109]. A person of ordinary skill in the art would have understood that Wang's electrode tabs are also internally welded to its current collector by ultrasonic

welding, as this was, at the time of the priority date of the '352 Patent, and continues to be now, the industry standard for internal welding in lithium-ion batteries, due to the thin copper and aluminum current collectors used in lithium-ion batteries. *See supra* II.A.

86. Ultrasonic welding involves the use of a high frequency of ultrasonic energy to produce oscillating shears to create solid-state bonds between two sheets clamped under pressure and at elevated but relatively low temperatures. Ex. 2005 at 3. Ultrasonic welding can be used to join a wide range of types of metal sheets or thin foils and is thus a suitable method for welding electrode tabs to current collectors in lithium-ion batteries due to its low operating temperature and good welding performance for the thin aluminum and copper current collectors used in lithium-ion batteries, as well as other highly conductive materials. *Id*.

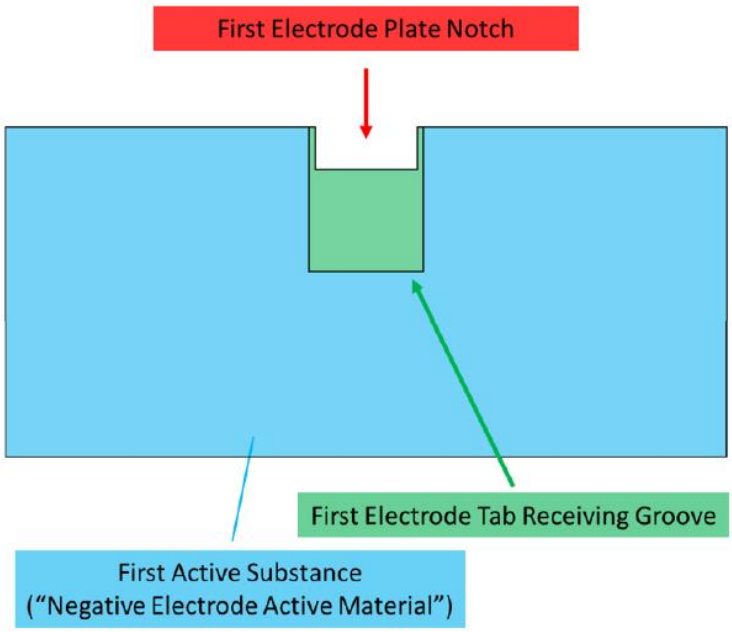
87. Deng's purported benefit of reducing heat accumulation and warping caused by the high heat from resistance welding Deng's electrode tab to Deng's electrode is not an issue for the lithium-ion battery of Wang or the '352 Patent, which a person of ordinary skill in the art would understand not to use resistance welding, but rather, ultrasonic welding (*see* Ex. 1004, [0043], [0048], [0109]), a technology that does not produce the substantial heat and warping produced by the resistance welding method described in Deng. Ex. 1005, [1002], [0007]. As a result and in addition to the fact that resistance welding would not be considered at all, there

would have been no reason for a person of ordinary skill in the art to consider heat dissipation and warping from resistance welding when internally welding electrode tabs to current collectors in lithium-ion batteries such as that of Wang because these are not problems found in lithium-ion batteries that rely on ultrasonic welding for internally welding electrode tabs to current collectors.

88. Further and as described *supra* § IV.A, resistance welding relies on the electrical resistance at the metal interface produced by a high electrical current to cause a localized heating and fusion of materials. As a result, resistance welding would burn, melt, and/or damage Wang's thin current collector rendering Wang's lithium-ion battery inoperable. The damage that would likely be caused by resistance welding further demonstrates that the reference would not have been considered by a person of ordinary skill in the art in improving or modifying Wang.

c. Petitioner's Proposed Modification Would Render Wang's Current Collector Susceptible to Damage and Tearing

89. Petitioner asserts that a person of ordinary skill in the art would modify Wang with Deng's notch, providing the following unsupported visualization of Wang's modified notch from a top-down view, including an unsupported "First Electrode Tab Receiving Groove" and an unsupported and comparatively deep "First Electrode Plate Notch" drawn in by Petitioner. Pet. at 31.



Id.

90. As I explained *supra* § IV.A, lithium-ion batteries employ very thin current collectors. *See, e.g.*, Ex. 2006 at 236-37 (describing exemplary "standard current collector thicknesses of 9 μm for the anode Cu foil and 15 μm for the cathode Al foil" at the time of the priority date of the '352 Patent). The unsupported notch in Petitioner's proposed combination of Wang and Deng appears comparatively deep, is not a structure that is normally made in lithium-ion batteries, and fails to appreciate the very thin and fragile nature of current collectors in lithium-ion batteries such as that of Wang.

91. In fact, a person of ordinary skill in the art would understand that Petitioner's proposed notch in Wang is so deep that it would weaken the fragile, thin current collector of Wang and render it susceptible to damage and tearing

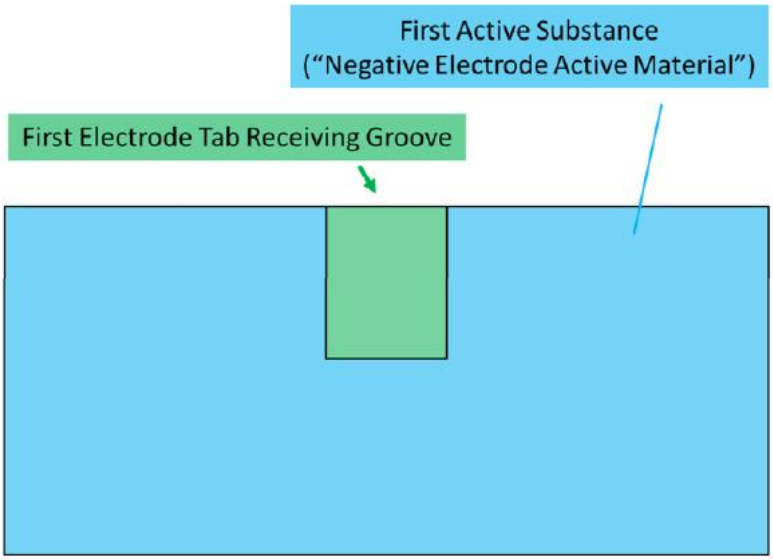
during subsequent manufacturing steps. A person of ordinary skill in the art would understand that such susceptibility to damage and tearing would substantially reduce production yields. As such, a person of ordinary skill in the art reading Wang's lithium-ion battery and Deng's flat metal plate type battery would not be motivated to modify Wang with Deng to create such a deep notch.

d. Even if Wang and Deng are Combined as Proposed by Petitioner, the Resulting Notch Does Not Disclose the Claimed First Electrode Plate Notch

92. Even assuming that a person of ordinary skill in the art would be motivated to modify Wang with Deng's notch as proposed by Petitioner (which a person of ordinary skill in the art would not be motivated to do, as explained above), the resulting notch would not be the claimed "first electrode plate notch" because it would not be "disposed on a side edge of the first electrode tab receiving groove" that is "defined by an exposed portion of the first surface of the first current collector and the first active substance on a periphery of the first electrode tab receiving groove," as required by claim 1. Ex. 1001, Claim 1.

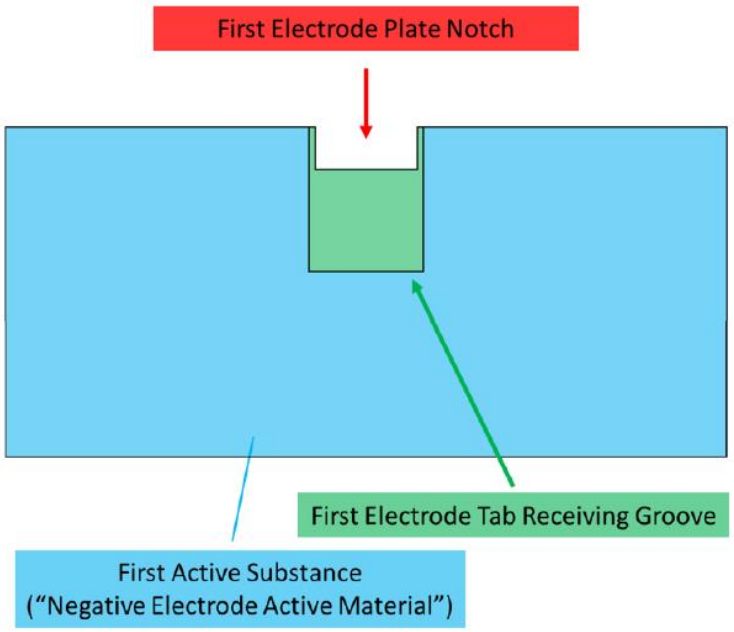
93. First, Petitioner's unsupported first electrode tab receiving groove illustrated in Petitioner's unsupported top-down view of Wang's electrode below is an incorrect projection of Wang because Wang employs ***patch coating*** to create "island areas" such as its electrode tab receiving groove, which requires an area or strip *across the entire width of the electrode* to be uncoated. *See supra* § IV.A; Ex.

1004, [0007], [0047]-[0049]. Yet in the figure below, Petitioner shows active material removed from only one side, or edge, of the electrode, which a person of ordinary skill in the art would understand is not possible with the patch coating method used in Wang.



Pet. at 23.

94. It is my opinion that Petitioner further compounds its erroneous, unsupported visualization of Wang's top-down view, by asserting that modifying Wang's electrode with Deng's notch would result in the unsupported first electrode plate notch drawn in by Petitioner in the figure below.



Pet. at 31.

95. Petitioner does not provide any basis for why Deng's notch, when combined with Wang's electrode, would look as illustrated in the figure above, only providing the conclusory statement that "[b]ased on Wang's disclosure, a person of ordinary skill in the art would have understood that the notch in the modified Wang negative electrode would appear in a top-down view as shown in the figure [above]. Ex. 1002, ¶77." Pet. at 31. Instead, as admitted by Petitioner, Wang discloses that a negative electrode tab is received by and is parallel to the alleged first tab receiving groove. *Id.* at 23-24. In contrast to the alleged first tab receiving groove that is parallel to the negative electrode tab, Deng discloses that its notch is "perpendicular to a welding direction." Ex. 1005, [0004]. As such, if notch 2 of Deng were to be

added to Wang, it would not be in the direction suggested by Petitioner but would be in the direction perpendicular to the alleged first tab receiving groove and the tab.

96. For the above reasons, not only does Petitioner's unsupported notch in its proposed combination of Wang and Deng lack any support or basis, but even assuming that such a notch were to be made as proposed by Petitioner, it would not read on the claimed first electrode plate notch, and thus Petitioner's proposed combination of Wang and Deng fails.

2. Claims 2-3 and 5-12 Are Not Unpatentable

97. Claims 2-3 and 5-12 are not unpatentable for the same reasons as discussed above with respect to claim 1 and at least because they depend from claim 1. I reserve the right to address claims 2-3 and 5-12 individually if this proceeding is instituted.

B. Ground 2: Wang and Zhou Do Not Render Obvious Claims 1-3 and 9-12

98. Petitioner contends that Wang and Zhou render obvious claims 1-3 and 9-12 of the '352 Patent. These claims recite:

> 12. A separator, comprising: a porous substrate; and
>
> a porous layer arranged on a surface of the porous substrate, wherein the porous layer comprises inorganic particles and a binder, and a ratio of Dv90 of the inorganic particles to the thickness of the porous layer is in a range from 0.3 to 3.0.
>
> 12. A secondary battery, comprising:

a first electrode tab;

a first electrode plate, comprising:

a first current collector; and

a first active substance, disposed on a first surface of the first current collector and a second surface of the first current collector, wherein the second surface is opposite to the first surface;

a first electrode tab receiving groove, defined by an exposed portion of the first surface of the first current collector and the first active substance on a periphery of the first electrode tab receiving groove, the first electrode tab receiving groove receiving the first electrode tab, wherein the first electrode tab is electrically connected with the first current collector through the first electrode tab receiving groove;

a first recess that is opposite to the first electrode tab receiving groove, defined by a corresponding portion of the second surface of the first current collector and the first active substance on a periphery of the first recess;

a first electrode plate notch disposed on a side edge of the first electrode tab receiving groove and extending through the second surface and the first surface of the first current collector; and

the first electrode tab receiving groove is formed by the first current collector and at least two first active substance walls;

wherein the secondary battery is a wound-type secondary battery.

2. The secondary battery according to claim 1, further comprising:

a second electrode tab;

a second electrode plate, comprising:

a second current collector; and

a second active substance, disposed on a surface of the second current collector;

a second electrode tab receiving groove, configured to receive the second electrode tab, wherein the second electrode tab is electrically connected with the second current collector through the second electrode tab receiving groove; and

a second electrode plate notch disposed on a side edge of the second electrode tab receiving groove and extending through the surface of the second current collector.

3. The secondary battery according to claim 2, wherein:

the first electrode plate is an anode electrode plate;

the first current collector is an anode current collector;

the first active substance is an anode active substance;

the first electrode tab is an anode electrode tab;

the first electrode tab receiving groove is an anode electrode tab receiving groove;

the first recess is an anode recess;

the first electrode plate notch is an anode electrode plate notch;

the second electrode plate is a cathode electrode plate;

the second current collector is a cathode current collector;

the second active substance is a cathode active substance;

the second electrode tab is a cathode electrode tab;

the second electrode tab receiving groove is a cathode electrode tab receiving groove; and

the second electrode plate notch is a cathode electrode plate notch.

9. The secondary battery according to claim 1, wherein:

the first electrode tab receiving groove is defined by the first active substance and extends to the first surface of the first current collector; and

the first electrode plate notch extends through the first current collector from the first surface of the first current collector.

10. The secondary battery according to claim 2, wherein:

the second electrode tab receiving groove is defined in the second active substance and extends to the surface of the second current collector; and

the second electrode plate notch extends through the second current collector from the surface of the second current collector.

11. The secondary battery according to claim 1, wherein a whole of the first electrode tab is parallel with the first surface of the first current collector.

12. The secondary battery according to claim 1, wherein a bottom of the first electrode plate notch is located between the first active substance disposed on two opposite sides of the first electrode tab receiving groove in the length direction of the first electrode plate.

1. Petitioner Fails To Show That Wang and Zhou Render Obvious Claim 1

99. I understand that Petitioner asserted that "a POSITA would have been motivated to similarly modify Wang's electrode, including by etching a region of

the current collector to which the tab of the first (e.g., anode) electrode is to be welded to the current collector." Pet. at 68. I further understand that Petitioner asserted that "Zhou's rationale for plasma etching the current collector is identical to the rationale the '352 patent provides for its notch: burr removal." *Id*.

100. It is my opinion that Petitioner's positions with respect to Ground 2 are equally as deficient as those of Ground 1. First, Wang relies on patch coating as its technique to coat its current collector with active material. A person of ordinary skill in the art would understand that patch coating does not result in burrs, certainly not burrs that would be addressed by the claimed notch, or by Zhou. Next, Zhou discloses etching the entirety of the length of a current collector such that the length of current collector is indented as compared to the Zhou active material. This indented current collector is essential to Zhou's intended purpose of reducing the likelihood of damage to the separator and Zhou instructs that the integrity of the positive electrode film 20 coating is not to be affected. That said, etching along the entire length of Zhou would create a different structure separate and distinct from the claimed notch or groove. Finally, even if a notch were formed as proposed by Petitioner, the resulting structure could never be the claimed notch which is "disposed on a side edge of the first electrode tab receiving groove," which is in turn "defined by an exposed portion of the *first surface of the first current collector* and

the first active substance on a periphery of the first electrode tab receiving groove." Ex. 1001, Claim 1. For at least these reasons, Petitioner's Ground 2 fails.

a. Wang Creates Its Grooves By Patch Coating, Obviating the Need for the Claimed First Electrode Plate Notch

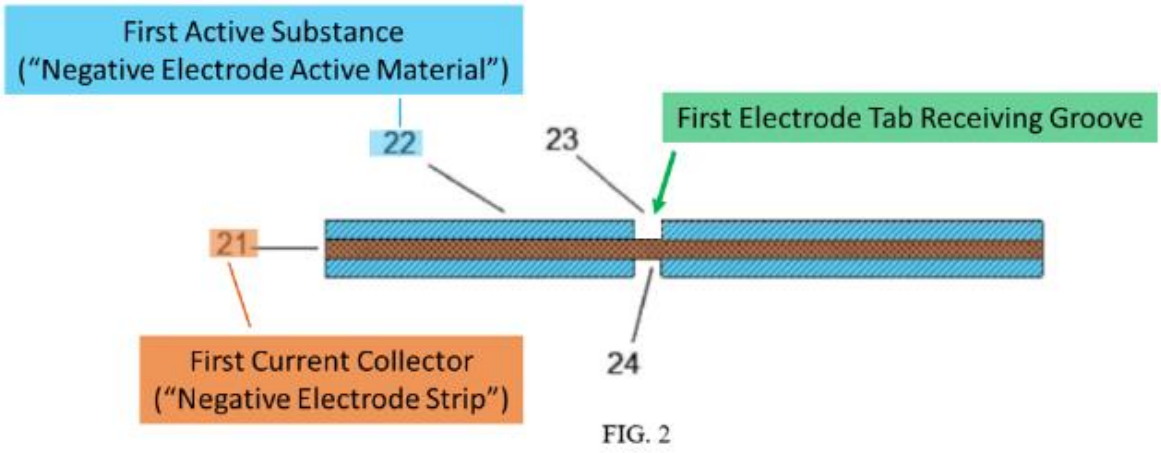
101. I understand that Petitioner and Dr. von Sacken assert that an uncoated area of Wang's negative electrode strip 21 is the claimed "first electrode tab receiving groove." Pet. at 20-23, 61; Ex. 1002, 62-66. Specifically, Petitioner states that:

> Wang discloses a first electrode tab (e.g., negative electrode tab) disposed in the middle area of a first current collector (e.g., negative electrode strip). Ex. 1004, ¶[0065], Fig. 2; Ex. 1002, ¶62. In preparing the surface of the current collector to which the negative electrode tab is later attached, Wang describes first coating the "negative electrode active material 22 onto the surfaces" of "a negative electrode strip 21" where "an area of [the] negative electrode tab 23" on the negative electrode strip is "not coated with the negative electrode active material 22." Ex. 1004, ¶[0101]. The negative electrode tab is later welded to the uncoated area. Ex. 1004, ¶[0106].
>
> A POSITA would have understood that the "area" of the negative electrode tab that is "not coated with the negative electrode active material 22" (Ex. 1004, ¶[0101]) is an exposed portion of the surface of the negative electrode current collector to which the electrode tab is

later welded and electrically connected, and is thus the claimed "first electrode tab receiving groove." Ex. 1002, ¶63.

Pet. at 20-21.

102. Reproduced below is Petitioner's annotated Fig. 2 of Wang illustrating the uncoated area of Wang that Petitioner alleges is the claimed first electrode tab receiving groove.



Pet. at 21, 61.

103. As described *supra* § IV.A, the coating method from Wang that Petitioner refers to is an old and widely used coating method in the lithium-ion battery industry known as "patch" or "gap" coating.[3] Wang's alleged invention

[3] In lithium-ion cell "patch" or "gap" coating, the active material of an electrode is coated on the current collector of the electrode while leaving certain uncoated

employs this "patch" or "gap" coating method to produce uncoated "island areas" in certain locations of the positive and negative electrode strips, including for an electrode tab receiving groove, to prevent lithium plating resulting from a positive electrode active material facing the negative electrode tab when the electrodes are wound. Ex. 1004, [0007], [0047]-[0049]. Wang specifically refers to the "island areas" and makes clear that these areas "prevent[] lithium plating caused by a positive electrode active material facing the negative electrode tab":

> [I]n the present invention, island area is a widely known term in the art and refers to an uncoated foil area that is not coated with any positive electrode active material on a positive electrode strip facing the front and back surfaces of a weld area of a negative electrode tab once a cell is wound.
>
> ….
>
> The present invention provides the following benefits:
>
> …
>
> In the present invention, a positive electrode first island area and a positive electrode second island area that are not coated with any active materials are disposed at certain distances on two sides from the positive electrode tab of the lithium-ion battery; when wound, the

"island" areas extending across the entire width of the current collector to provide access to the current collector for making an electrical connection to electrode tabs.

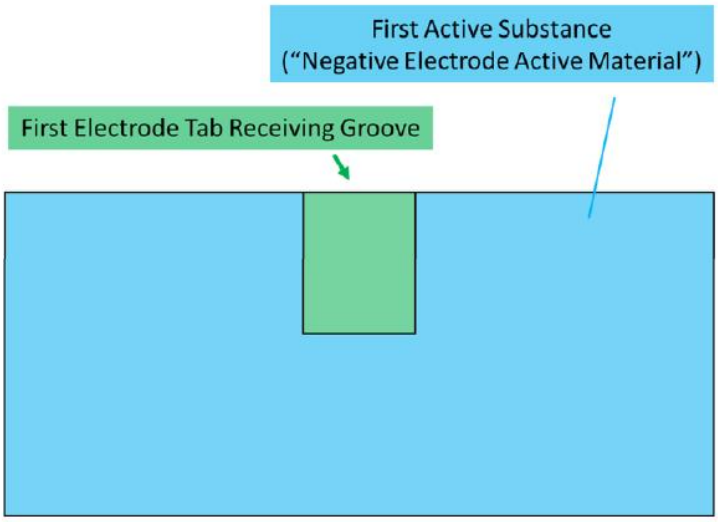
> positive electrode second island area and the positive electrode first island area correspond to and cover the negative electrode tab and its back side, respectively, thereby preventing lithium plating caused by a positive electrode active material facing the negative electrode tab.

Id., [0007], [0047]-[0049].

104. A person of ordinary skill in the art would understand that creating an uncoated area in the active material of a lithium-ion battery by patch coating requires the entire width of an area of a current collector or electrode to be uncoated so as to form an uncoated "island" or "strip." While Wang doesn't show a top-down view of its electrode, a person of ordinary skill in the art would have understood that Wang's uncoated islands, including Wang's tab receiving groove, would run the entire width of Wang's current collector or electrode so as to form strips of uncoated recessed areas.

105. While Petitioner acknowledges that "Wang does not provide a top-down perspective view of its negative electrode" and attempts to create its own, Petitioner fails to appreciate, in my opinion, that Wang's uncoated islands, including Wang's tab receiving groove, would run the entire width of Wang's electrode. Pet. at 22. Instead, Petitioner erroneously shows a top-down view of Wang's electrode where an unsupported electrode tab receiving groove is present only on one side, or

edge, of the electrode. *Id.* at 22-23. These figures ***have no support*** and are at odds with the disclosure of Wang.



Pet. at 23.

106. A person of ordinary skill in the art would understand that it would not be possible to form an uncoated tab receiving groove using patch coating in just a one side of Wang's electrode as illustrated in Petitioner's unsupported figure above because Wang's patch coating process requires an uncoated patch or island area to run across the entire width of the electrode, and not just on a select portion of the electrode as shown in Petitioner's figure above. As a result, it is my opinion that Petitioner's annotated figure is unsupported by Wang.

107. In contrast to the "patch" or "gap" coating of Wang, Petitioner states that the '352 Patent discloses a notch that "can remove the burrs formed on the current collector 1011 of the edge part of the anode electrode tab receiving groove

1013 during formation," thus "effectively preventing the secondary battery 1 from generating internal short circuit, and in turn improving the safety performance of the secondary battery 1 while ensuring a high energy density." Pet., 12 (citing Ex. 1001, 3:50-65, Fig. 5(a); Ex. 1002, ¶32) *see also* Ex. 2001, ¶ 107.

108. The '352 Patent explains that one problem with prior art lithium-ion batteries is that burrs in localized areas can pierce the separator and cause internal short circuit and other safety hazards:

> Furthermore, the laser cleaned groove on the electrode plate has an overheated perforation or a burned hole on the edge due to focal length fluctuation and deviation, such that a plenty of burrs are formed on a current collector on the edge of the groove; if the electrode plate with burrs is directly manufactured into a cell without processing, then the burrs will pierce the separator to cause internal short circuit, a fire disaster and other severe potential safety hazards.

Ex. 1001, 1:27-34.

109. The '352 Patent discloses:

> In the secondary battery according to the present invention, the anode electrode tab is received in the anode electrode tab receiving groove, and the cathode electrode tab is received in the cathode electrode tab receiving groove, thus effectively improving the energy density of the secondary battery; the anode electrode plate die-cut notch can remove the burrs formed on the current collector on the edge part of the anode electrode tab receiving groove during formation, and the cathode

> electrode plate die-cut notch can effectively remove the burrs formed on the current collector on the edge part of the cathode electrode tab receiving groove during formation, thus effectively preventing the secondary battery from generating internal short circuit, and improving the safety performance of the secondary battery while ensuring a high energy density.

Ex. 1001, 2:26-40; *see also* 3:50-65, 7:58-8:3, 13:43-50, 14:58-67.

110. Wang's alleged electrode tab receiving groove, which is created by "patch" or "gap" coating certain areas of its electrode strip with active material and leaving other "island areas" uncoated, does not produce the types of burrs described in the '352 Patent because they are not created using laser ablation. In addition, because patch coating requires not coating active material in a narrow strip or "island area" across the entire width of the electrode, employing Wang's patch coating method would remove much more active material than what is contemplated by the '352 Patent, and result in lower cell energy density, more material waste and cost inefficiency.

111. In view of the patch coating method disclosed by Wang, a person of ordinary skill in the art would understand that there would be no burrs to remove from Wang's patch coated electrodes in the location alleged by Petitioner and, thus, even if it were possible to create a notch in Wang in the way described by Petitioner,

a person of ordinary skill in the art would have no reason or motivation to create the claimed first electrode plate notch in Wang's battery.

b. A Person of Ordinary Skill in the Art Would Not Have Combined Wang and Zhou

112. Petitioner asserts that "Zhou discloses a method of removing electrode burrs at the edge of an electrode current collector using gas plasma etching." Pet. at 61 (citing Ex. 1013, ¶¶[0008], [00015], Ex. 1002, ¶140). Petitioner acknowledges that the process disclosed by Zhou etches a current collector along the entire length of the electrode. *Id*. at 58-69 (citing Ex. 1013, ¶¶[0001], [0007], [0008], [0015]). Petitioner confirms this interpretation through its annotated figures, and by noting that the result of etching across the entire length of Zhou's electrode is an "indented" current collector in which the current collector has a narrower width than Zhou's electrode coating. *Id*. at 59-62, 67.

113. In view of the admission that Zhou is a process that etches a current collector along the entire length of the electrode and the confirmation by Dr. von Sacken that "Zhou does not show the electrode tab receiving groove" (Ex. 1002, ¶141), it is non-sensical that Petitioner assumes that "a POSITA would have understood that Zhou's electrode tab receiving groove would appear in a top down view, for example, as shown in annotated Figure 2 below." Pet. at 62–63 (illustrating the fictional Figure 2). Next, and based entirely on its own erroneous assumption,

Petitioner asserts that this groove, which is not shown in or described in Zhou, would further "include[] an electrode plate notch disposed on a side edge of the electrode tab receiving groove in the same manner that the '352 patent's 'anode electrode plate die-cut notch 1014' is disposed on a 'side edge' of an 'anode electrode tab receiving groove 1013'" and that "Zhou's notch extends entirely through the current collector (e.g., in a top-to-bottom direction in Figure 3), and thus extends through the current collector's first and second surfaces." Pet. at 63-64. Petitioner and its expert cannot support these naked and conclusory assertions, which contradict Zhou's actual disclosure.

114. Petitioner finally asserts that Zhou's rationale of removing burrs by plasma etching the current collector is identical to the rationale of removing burrs that the '352 Patent provides for its notch. *Id*.

115. Petitioner is simply wrong. The burrs formed in Zhou are a result of slitting or cutting the electrode along the entire length of the electrode during bulk processing and are entirely distinct from the burrs addressed by the '352 Patent's first electrode plate notch, which are caused by laser ablation in a localized area of the active substance where the first electrode tab receiving groove is formed. As such, Petitioner's sole rationale for the combination fails.

(i) Zhou Does Not Disclose a First Electrode Tab Receiving Groove or First Electrode Plate Notch

116. As noted above, Petitioner asserts that:

> Zhou describes etching the current collector, and thus creating the electrode plate notch, at an exposed area of the current collector where an electrode tab will later be welded to the current collector (the claimed "electrode tab receiving groove"). Ex. 1013, ¶[0025] (cautioning against making the current collector etch depth "too great," which "will cause unnecessary damage to an area on the positive electrode current collector 10 that is not covered by a positive electrode active material, thereby affecting tab welding in a subsequent step."); Ex. 1002, ¶141.

Pet. at 62-63.

117. Petitioner then, without any support that I can identify, asserts that an undisclosed groove would "appear" in a top-down view of Zhou to create a new and unsupported figure with an unsupported Electrode Tab Receiving Grove that is in direct conflict with what is disclosed in Zhou and shown in Zhou's figures:

> Zhou does not show the electrode tab receiving groove (e.g., the "area on the positive electrode current collector 10 that is not covered by a positive electrode active material") in its figures, but based on Zhou's disclosure, a POSITA would have understood that Zhou's electrode tab receiving groove would appear in a top-down view, for example, as

shown in annotated Figure 2 below. Ex. 1013, ¶[0025], Fig. 2; Ex. 1002, ¶141.

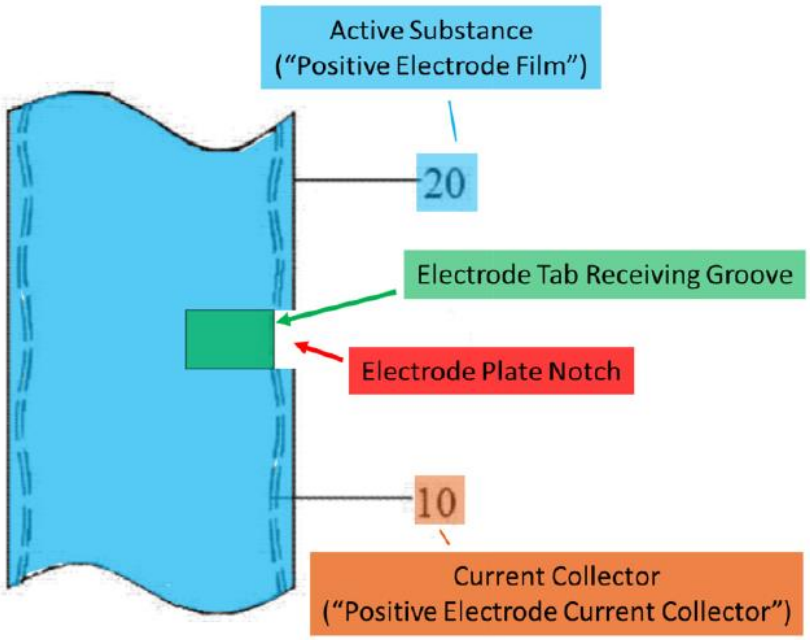


FIG. 2

Pet. at 63.

118. In contrast to the above figure created by Petitioner and in my opinion, Zhou discloses a continuously coated electrode that does not have an uncovered region ***at all***, which means that the entirety of the current collector is covered by active material. Ex. 1013, Fig. 2. Further, Zhou does not create an electrode tab receiving groove or electrode plate notch at all but instead etches the current collector 10 along the entire length of its electrode so that the entirety of the current collector 10 is indented as compared to the positive electrode film 20. *Id.* Indeed, Zhou discloses that the entire length of the current collector would have been etched

"***without affecting the shape of the edge of the positive electrode or the integrity of the positive electrode film 20 coating***" further undercutting Petitioner's alleged modification that would certainly impact the shape of the edge of the electrode. Ex. 1013, ¶[0037].

119. In addition, Zhou discloses that burrs form from "electrode cutting," and the aluminum foil serving as the current collector will "have edges that are level with or slightly protrude over edges of a positive electrode film 240 and have some burrs that resulted from cutting." Ex. 1013, [0004]. Zhou is using the term "electrode cutting" for what is commonly known in the industry as "slitting." Slitting uses knife edge wheels to slit wide electrode reels from a coater to the width required for the cells being manufactured. Slitting is performed in a high-speed roll-to-roll process down the electrode web. It is a known problem in the industry that if the knife edges used in slitting are nicked or damaged, they can cause burrs along the cut edge of the electrode. The burrs in Zhou, thus, are of a different character from those of the '352 Patent in that they can occur at any point down the entire length of the current collector and are a result of slitting the electrode. In the '352 Patent, on the other hand, the burrs are formed in a localized area of the current collector as a result of laser ablation performed to remove some of the active substance from the electrode so as to create the claimed first electrode tab receiving groove.

120. In order to address its particular burrs caused by splitting, Zhou offers a specific mitigation strategy whereby Zhou etches the entire electrode 2 along the entire length of the current collector 10 by gas plasma etching using gases that selectively etch only the current collector 10 and not Zhou's active substance ("electrode film 20"). Ex. 1013, [0030]-[0033], Fig. 4. I reproduce Figure 4 of Zhou below, which illustrates Zhou's gas plasma etching apparatus treating Zhou's entire electrode 2 with a mixture of gas particles.

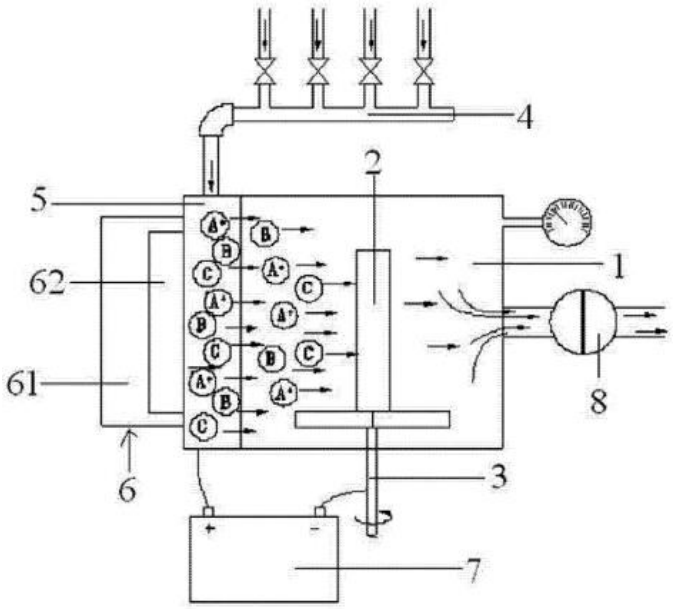


FIG. 4

Ex. 1013, Fig. 4.

121. Zhou's gas particles react with and etch only Zhou's current collector 10, and not Zhou's positive electrode film 20. Ex. 1013, [0033], Fig. 3. As a result, Zhou's current collector 10 is "indented" relative to Zhou's electrode film along the

entire length of Zhou's electrode, as shown by indented current collector 10 in reproduced Figs. 2 and 3 of Zhou below:

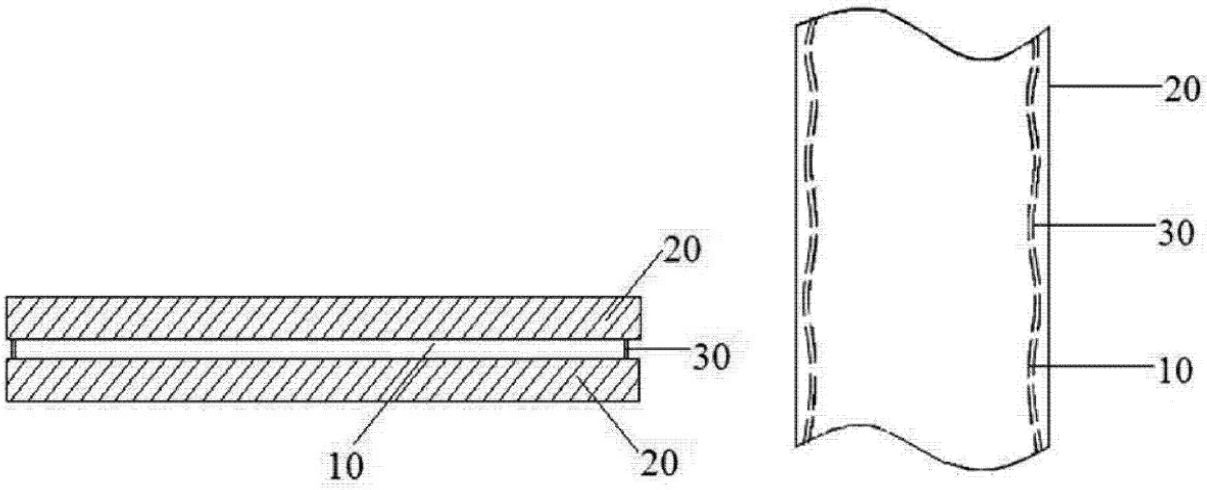


FIG. 3 FIG. 2

Ex. 1013, Figs. 2-3.

122. As shown in Zhou, a "top-view diagram illustrating the present utility model" does not show a groove or notch because Zhou discloses a continuously coated electrode and the positive electrode film is specifically designed to extend past the edge of the etched current collector. Ex. 1013, [0018], Fig. 2 *compare* Pet. at 63 (illustrating an unsupported modification of Fig. 2 of Zhou).

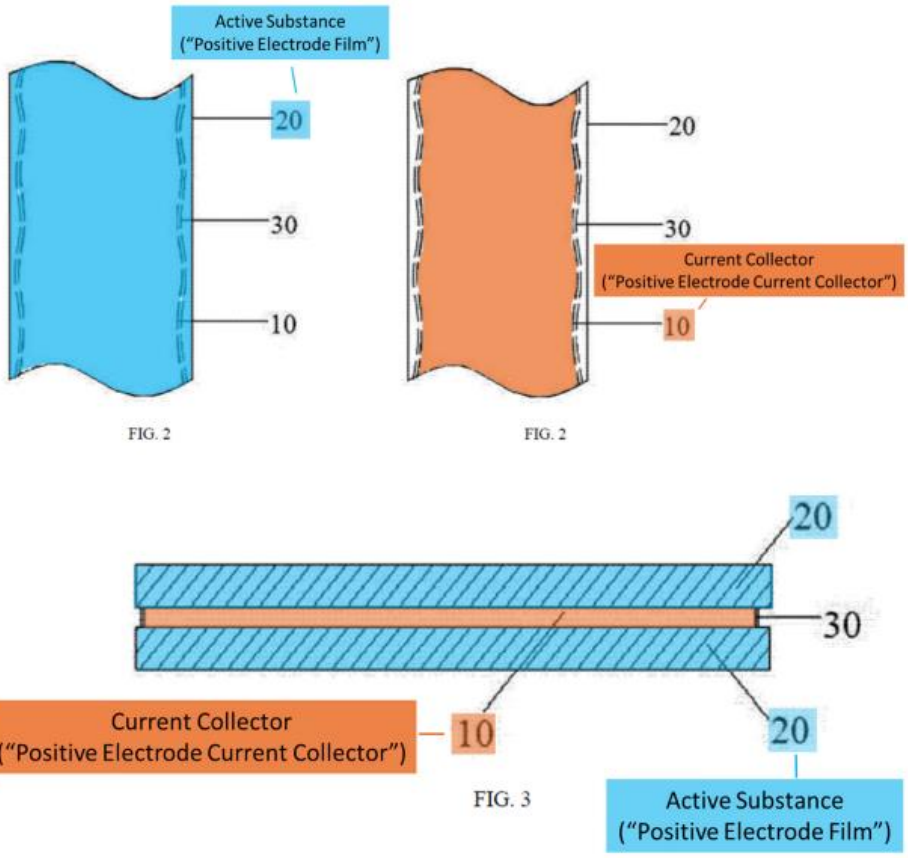
123. Zhou teaches that its indented current collector mitigates the fact that not all burrs may be removed. The indentation allows for the current collector to be insulated by the oxide layer and further allows for the current collector to have a width that is less than the width of the positive electrode film 20 so as to prevent the risk of unremoved burrs or rough surfaces resulting from the etching extending out

and piercing through a separator. Ex. 1013, ¶[0015]; *see also* ¶[0021] ("Having the oxide layer 30 disposed can prevent the risk of unremoved burrs or rough surfaces resulting from the etching extending out and piercing through a separator."). Indeed, Zhou discloses that the entire length of the current collector would have been etched "without affecting the shape of the edge of the positive electrode or the integrity of the positive electrode film 20 coating" so that the current collector "will not be able to pierce through the separator and short-circuit on contact with the negative electrode film." Ex. 1013, ¶[0037].

124. Taken together, these disclosures would make apparent to a person of ordinary skill in the art that the entire current collector is etched such that the width of the positive electrode current collector 10 is less than the width of the positive electrode film 20. Ex. 1013, ¶[0021]. Etching the entire current collector such that the entire surface of the current collector would be indented at the same depth would not result in "a first electrode tab receiving groove, defined by an exposed portion of the first surface of the first current collector and the first active substance on a periphery of the first electrode tab receiving groove" and certainly would not result in an electrode tab receiving groove appearing in a top-down view of Zhou, or a first electrode plate notch "disposed on a side edge of the first electrode tab receiving groove." Ex. 1001, Claim 1.

125. I understand that Petitioner also asserts that "based on Zhou's disclosure, a person of ordinary skill in the art would have understood that Zhou's electrode tab receiving groove would appear in a top down view," apparently based on the fact that Zhou "caution[ed] against making the current collector etch depth 'too great,' which 'will cause unnecessary damage to an area on the positive electrode current collector 10 that is not covered by a positive electrode active material, thereby affecting tab welding in a subsequent step.'" Pet. at 62-63; Ex. 1013 [0025]. Petitioner does not provide any basis or explanation as to why these statements support the placement of an electrode tab receiving groove illustrated in Petitioner's unsupported figure on page 63 of the Petition.

126. Instead, the only area of the current collector that is shown in Figures 2 and 3 of Zhou "that is not covered by a positive electrode active material" is the edge that has been treated by gas plasma etching. Ex. 1013, Figs. 2-3, [0021]. Petitioner illustrates these uncovered areas in orange below:



Pet. at 62.

127. Regardless of the lack of any explanation in Zhou that would suggest a tab receiving grove that would appear in a top-down view, Zhou's cautions against a particular etch depth are unrelated to any suggestion to create a groove or notch in Zhao's current collector, but instead are directed to the impact of etching the entirety of current collector. The purpose of Zhou's etching is to eliminate burrs while having an etch depth that allows the oxide layer to insulate the current collector such that any burrs remaining on the current collector will not pierce through the separator. Ex. 1013, [0021]-[0022]. In fact, Zhou discloses: "[t]he large[r] the distance of

indentation, the better the safety performance because burrs that may not have been removed and rough bumps that resulted from the gas etching are all covered by the film on the outside." Ex. 1013, [0025].

128. Noting the potential of a large edge depth, Zhou discloses that etching of the entire current collector may cause "unnecessary damage to an area on the positive electrode current collector 10 that is not covered by a positive electrode active material." *Id*. Zhou also states that its gas plasma etching method "removes the cut edge and burrs of the [current collector]… without affecting... the integrity of the [] electrode film coating," indicating that Zhou is concerned about weakening the electrode film coating by over-etching the underlying current collector, which could result in creating particulates, a known safety hazard for lithium-ion cells. Ex. 1013, [0037]. As a result, these cautions by Zhou only suggest to a person of ordinary skill in the art that there is a need to balance the amount of the entire length of current collector that is removed for the purposes of mitigating burrs with the need to maintain the functionality and viability of the current collector. *Id*. Nothing more should be or can be drawn from these disclosures.

129. Zhou is silent with regard to any additional steps needed for internal tab welding. In fact, other than mentioning the need for the current collector to not be damaged, Zhou says nothing further regarding internal tab welding, and certainly says or suggests nothing about the claimed first electrode tab receiving groove, or

the claimed first electrode plate notch "disposed on a side edge of the first electrode tab receiving groove.".

130. It is therefore my opinion that Zhou does not suggest or disclose the claimed first electrode tab receiving groove, or the claimed first electrode plate notch "disposed on a side edge of the first electrode tab receiving groove." Instead, Zhou discloses that the entirety of the current collector 10 is indented as compared to the positive electrode film 20 "without affecting the shape of the edge of the positive electrode or the integrity of the positive electrode film 20 coating." Ex. 1013, ¶[0037].

(ii) Zhou's Burrs Present a Separate and Distinct Problem From The Problem Solved by the '352 Patent and The Disclosure of Wang

131. Petitioner's sole rationale for the combination of Wang and Zhou is "burr removal." Pet. at 68. As an initial matter, and as described *supra* § VI.B.1.a, Wang's electrode tab receiving groove, which is created by "patch" or "gap" coating certain areas of its electrode strip with active material and leaving other "island areas" uncoated, does not produce burrs of the type and location alleged by Petitioner. Because there are no burrs to remove from Wang's patch coated electrodes in the location alleged by Petitioner, a person of ordinary skill in the art would have no reason or motivation to create the claimed first electrode plate notch in Wang's battery. *See* Pet. at 68; *see supra* § VI.B.1.a.

132. Regardless of the disclosure of Wang, Petitioner specifically notes that "burr removal" is the reason provided by the '352 Patent for the inclusion of the notch. *Id*. However, a person of ordinary skill in the art would have understood that the "burr removal" process in the '352 Patent is separate and distinct from the "burr removal" process in Zhou. *Id*. As a result, the mere mention of "burr removal" in Zhou does not provide support for the proposed combination and certainly does not support Petitioner's sole rationale for the combination being that the burr removal in Zhou is the same as that of the '352 Patent. Pet. at 68-69.

133. As explained above, these burrs of the '352 Patent are formed from the high heat of the pulsed laser beams used in laser ablation. And as explained *supra* § VI.B.1.a, the '352 Patent removes these burrs via a notch at the edge part of the electrode tab receiving groove formed by laser ablation. Ex. 1001, 2:26-40, 3:50-65, 7:58-8:3, 13:43-50, 14:58-67. That is, the burrs in the '352 Patent are localized to the edge part of the electrode tab receiving groove as a result of laser ablation. *Id.*

134. Zhou discloses that its burrs form from "electrode cutting" and that its positive electrode current collector will "have edges that are level with or slightly protrude over edges of a positive electrode film 240 and have some burrs that resulted from cutting." Ex. 1013, [0004]. As explained *supra* § VI.B.1.b.(i), Zhou's "electrode cutting" is referring to what is commonly known in the industry

as "slitting," which uses knife edge wheels to slit wide electrode reels from a coater to the width required for the cells being manufactured. Slitting is performed in a high-speed roll-to-roll process down the electrode web, and it is a known problem in the industry that if the knife edges used in slitting are nicked or damaged, they can cause burrs along the cut edge of the electrode. The burrs in Zhou, thus, are of a different character in that they can occur at any point down the entire length of the current collector and are a result of slitting the electrode.

135. Zhou teaches that the indented positive electrode current collector is insulated by the oxide layer on the outside so as to prevent the risk of unremoved burrs or rough surfaces resulting from the etching extending out and piercing through a separator. Ex. 1013, ¶[0015] *see also* ¶[0021] ("Having the oxide layer 30 disposed can prevent the risk of unremoved burrs or rough surfaces resulting from the etching extending out and piercing through a separator.").

136. A person of ordinary skill in the art would have understood that burrs located along the entire length of the current collector as taught by Zhou would not be mitigated by a single groove or notch and, thus, there would be no motivation to create a groove or notch as suggested by Petitioner. Instead, as disclosed by Zhou, the entire length of the current collector would have been etched "without affecting the shape of the edge of the positive electrode or the integrity of the positive electrode film 20 coating" so that the current collector "will not be able to pierce

through the separator and short-circuit on contact with the negative electrode film." Ex. 1013, ¶[0037]. As a result, a person of ordinary skill in the art would not have considered Zhou's "burr removal" or burr removal in general as a motivation to make the modifications asserted in the Petition.

(iii) A Person of Ordinary Skill in the Art Would (and Could) Not Etch Only a Select Area of Wang's Current Collector by Using Zhou's Gas Plasma Etching to Form the Claimed First Electrode Plate Notch

137. Petitioner also asserts that:

> In view of Zhou's stated benefits of plasma etching the current collector to remove electrode burrs that could damage the battery (Ex. 1013, ¶¶[0007]-[0008], [0015]), a POSITA would have been motivated to similarly modify Wang's electrode, including by etching a region of the current collector to which the tab of the first (e.g., anode) electrode is to be welded to the current collector. Ex. 1002, ¶147.

Pet. at 68.

138. Contrary to Petitioner's assertions, a person of ordinary skill in the art would not have been motivated to etch a localized region of Wang's current collector using Zhou's gas plasma etching method.

139. As explained above, Zhou discloses using gas plasma etching to etch the entire length of an electrode's current collector edge. Ex. 1013, [0030]-[0031], Fig. 4. The gas plasma etching process described by Zhou is an expensive process

to use on lithium-ion electrodes and is one that a person of ordinary skill in the art would likely implement in the bulk processing of large electrode rolls. For example, as described by Zhou, the process requires the use of a vacuum, specialized gases and a plasma generator, with the entire electrode exposed to the gas plasma for up to an hour, as described in paragraphs 31 and 32 of Zhou reproduced below:

> Next, the positive electrode was wound and placed on the rotatable tray rack 3; the tray was placed into the sealed vacuum chamber 1; a gas mixture (Cl_2, BCl_3, Ar, and O_2) flew from the gas distribution system 4 into the ionization chamber 5 at a volume ratio of (1-5):(1-5):(0.5-2):(5-15); and the electrode 62 of the plasma generator 6 produced an adequately strong magnetic field at the action of the radio frequency power supply 61 and converted the gas mixture that had entered into the ionization chamber 5 into a plasma.
>
> The negative bias power supply 7 formed an electric field between the ionization chamber 5 and the positive electrode; the plasma in the ionization chamber 5, at the action of the electric field, entered into the vacuum chamber 1, bombarded the positive electrode at a high speed, and reacted with the burrs (which were aluminum or aluminum oxide) at the cut edge of the exposed positive electrode current collector 10 of the positive electrode with a reaction time of 20-60 minutes, so as to remove the burrs from the positive electrode. The equations for the chemical reactions between these gases and the burrs are, respectively: $Al_2O_3+3BCl_3 \rightarrow 2AlCl_3+3BOCl$ (1); $2Al+3Cl_2 \rightarrow 2AlCl_3$ (2); $2Al+3O_2 \rightarrow 2Al_2O_3$ (3).

Ex. 1013, [0031]-[0032].

140. As such, a person of ordinary skill in the art would understand that Zhou's gas plasma etching process is designed for use in bulk processing of large rolls of electrode material, to etch the entire length of the electrode edge. It therefore would be difficult, if not impossible, to implement Zhou's gas plasma etching only on a select, localized region of Wang's current collector to create an alleged "first electrode plate notch," because in order to perform such etching, a person of ordinary skill in the art would need to first vacuum seal the selected region to be etched and then isolate the gas plasma to the narrow tab or groove area of the electrode while etching. Zhou would not be able to vacuum seal a select narrow area of the electrode edge (e.g., a few millimeters width), particularly using its gas chamber apparatus shown in its Figure 4, including around the area coated with the active substance, especially as there would have been hundreds or thousands of such tab areas on a full production roll of electrode material that would need such precision vacuum sealing. Therefore, not only would a person of ordinary skill in the art not be motivated use Zhou's gas plasma etching method on a select area of Wang's current collector, but it would also be infeasible to do so. For at least these reasons, a person of ordinary skill in the art would have understood that the modification proposed by Petitioner would not be viable.

2. Even Assuming a Person of Ordinary Skill in the Art Would Combine Wang and Zhou as Petitioner Proposes, the Resulting Structure Does Not Disclose the First Electrode Plate Notch

141. Even assuming that a person of ordinary skill in the art would have combined Wang and Zhou as proposed by Petitioner, the resulting structure would not result in the claimed "electrode tab receiving groove" or "first electrode plate notch" that is "disposed on a side edge of the first electrode tab receiving groove" and which is "defined by an exposed portion of the first surface of the first current collector and the first active substance on a periphery of the first electrode tab receiving groove." Ex. 1001, Claim 1.

142. In particular, Petitioner asserts that in its unsupported modification to Zhou's figure, Zhou discloses an electrode plate notch disposed on a side edge of the electrode tab receiving groove. Specifically, Petitioner states:

> As shown in the figure above, as a result of Zhou's current collector etching process, ***Zhou's electrode tab receiving groove includes an electrode plate notch disposed on a side edge of the electrode tab receiving groove in the same manner that the '352 patent's "anode electrode plate die-cut notch 1014" is disposed on a "side edge" of an "anode electrode tab receiving groove 1013,"*** as shown in '352 patent Figure 5(a) below. Ex. 1001, 3:14-45, Fig. 5a; Ex. 1002, ¶142. Moreover, as shown in annotated Zhou Figures 2 and 3 above, Zhou's notch extends entirely through the current collector (e.g., in a top-to-

bottom direction in Figure 3), and thus extends through the current collector's first and second surfaces. Ex. 1002, ¶142.

Pet., 63-64.

143. In order to demonstrate the resulting structure, Petitioner provides an annotated and modified figure from Zhou that allegedly illustrates how the "modified Wang negative electrode would appear in a top-down view." Pet. at 63. As is shown, the current collector does not define the alleged first electrode plate notch as it would have been etched away (e.g., there is no current collector outside of the double dashed lines below).

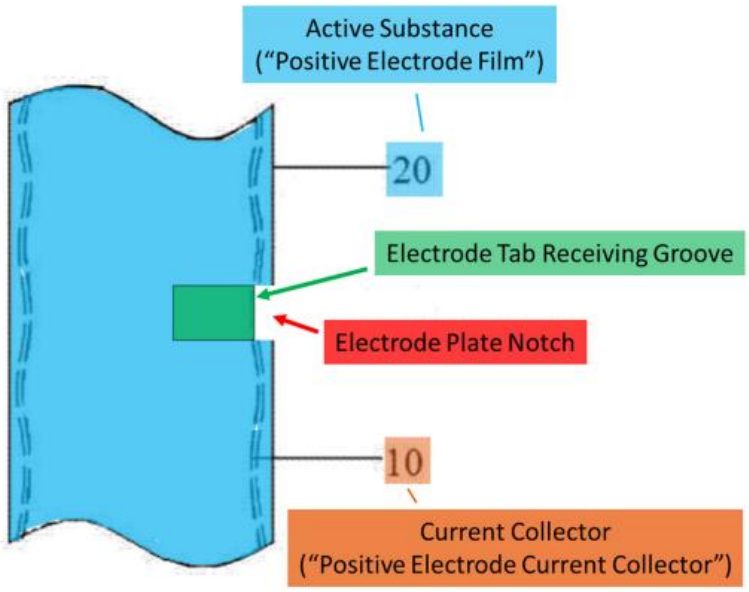
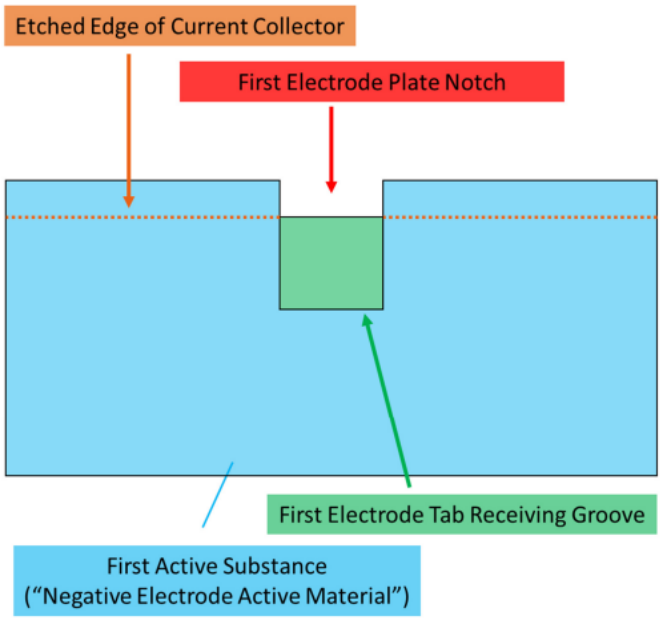


FIG. 2

Pet. at 63.

144. Below Petitioner adds an orange dashed line to signify where it claims the current collector ends with respect to the Negative Electrode Active Material (annotated in blue below).



Pet. at 67.

145. Petitioner states "a POSITA would have understood that a notch in the modified Wang negative electrode would appear in a top-down view as shown in the figure [above]." Pet. at 66. Viewed from the top and according to Petitioner, the modified disclosure of Wang would include an "Etched Edge of Current Collector" such that the current collector is narrower, when viewed from the top, than the "Negative Electrode Active Material." *Id*. at 66-67. As a result, outside of the "Etched Edge of Current Collector," there no longer is any current collector

remaining. That is, past the "Etched Edge of Current Collector," there is nothing between layers of "Negative Electrode Active Material."

146. However, to be the claimed "first electrode plate notch," the notch must "extend[] through the second surface and the first surface of the first current collector." Ex. 1001, Claim 1. A person of ordinary skill in the art would understand that the area defined by Petitioner as the "First Electrode Plate Notch" does not "extend[] through the second surface and the first surface of the first current collector" because the current collector has been etched away along the entirety of the current collector above the dashed orange line. Pet. at 67.

147. Moreover, the "first electrode plate notch" must be "disposed on a side edge of the first electrode tab receiving groove" that is "defined by an exposed portion of the first surface of the first current collector and the first active substance on a periphery of the first electrode tab receiving groove." Ex. 1001, Claim 1. But Petitioner's unsupported first electrode plate notch in its figure above cannot be "disposed on a side edge of the first electrode tab receiving groove" because it is located in the region above the dashed orange line where there is no current collector, and thus ***cannot be and is not*** "disposed on a side edge of the first electrode tab receiving groove" that is "***defined by an exposed portion of the first surface of the first current collector*** and ***the first active substance on a periphery of the first electrode tab receiving groove***." *Id.* In other words, there can be no first electrode

tab receiving groove in the area above the dashed line, and as such there can be no first electrode plate notch there. In addition, claim 1 confirms that the "first active substance" is "disposed on a first surface of the first current collector and a second surface of the first current collector." *Id*. However, a person of ordinary skill in the art would have understood that the positive electrode film in the modified Wang figure above is not "disposed on a first surface of the first current collector and a second surface of the first current collector" because the current collector in that section has already been etched away as is admitted in Petitioner's figure. Pet at. 67.

148. In sum, a person of ordinary skill in the art would have understood that once the current collector in Wang is etched along its entire length, as is required by Zhou and admitted by Petitioner to be part of its proposed combination, any area above the dashed orange line in Petitioner's proposed combination cannot house the first electrode tab receiving groove, and thus cannot house the first electrode plate notch, and Wang's "Negative Electrode Active Material" would no longer be disposed on a first surface of the current collector. Ex. 1001, Claim 1. Moreover, once the current collector was etched, any alleged notch in Zhou would not extend through "the second surface and the first surface of the first current collector." For this additional reason, it is my opinion that the combination fails to teach or suggest claim 1.

3. Claims 2-3 and 5-12 Are Not Unpatentable

149. Claims 2-3 and 5-12 are not unpatentable for the same reasons as discussed above with respect to claim 1 and at least because they depend from claim 1. I reserve the right to address claims 2-3 and 5-12 individually if this proceeding is instituted.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on the information and belief are believed to be true; and further 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 Title 18 of the United States Code.

Executed on July 28, 2023 in Livermore, CA.

James L. Kaschmitter