

SCORE Placeholder Sheet for IFW Content

Application Number: 18607737

Document Date: 03/18/2024

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via DAV or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.

Form Revision Date: March 1, 2019

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number			
	Filing Date		2024-03-18	
	First Named Inventor	Lilan ZHANG		
	Art Unit	TBD		
	Examiner Name	TBD		
	Attorney Docket Number	14850267COA		

U.S.PATENTS							Remove	
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear		
	1	9812739	B2	2017-11-07	KEFEI			
If you wish to add additional U.S. Patent citation information please click the Add button.							Add	
U.S.PATENT APPLICATION PUBLICATIONS							Remove	
Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear		
	1	20060147803	A1	2006-07-06	KIM et al.			
	2	20060035144	A1	2006-02-16	SHIMIZU et al.			
If you wish to add additional U.S. Published Application citation information please click the Add button.							Add	
FOREIGN PATENT DOCUMENTS							Remove	
Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ²	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	2019207755	JP	A	2019-12-05	Maxell Holdings LTD.		☐
	2	111342129	CN	B	2021-07-20	NINGDE AMPEREX TECHNOLOGY LTD.		☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number			
	Filing Date		2024-03-18	
	First Named Inventor	Lilan ZHANG		
	Art Unit	TBD		
	Examiner Name	TBD		
	Attorney Docket Number	14850267COA		

	3	110739487	CN	A	2020-01-31	DONGGUAN VEKEN BATTERY CO., LTD.		☐
	4	109361018	CN	A	2019-02-19	NINGDE AMPEREX TECHNOLOGY LTD.		☐
	5	110042439	CN	A	2019-07-23	FUJIAN QINGJING COPPER FOIL CO., LTD.		☐
	6	102668221	CN	A	2012-09-12	NEC ENERGY DEVICES LTD.		☐
	7	107251309	CN	A	2017-10-13	SAMSUNG SDI CO., LTD.		☐
	8	2018156803	JP	A	2018-10-04	ASAHI KASEI CORP.		☐
	9	107256980	CN	A	2017-10-17	HARBIN INSTITUTE OF TECHNOLOGY		☐
	10	102171869	CN	A	2011-08-11	EQUOS RES. K.K.		☐
	11	104505535	CN	A	2015-04-08	ZHUHAI SMOOTHWAY ELECTRONIC MAT CO., LTD.		☐
	12	105057354	CN	A	2015-11-18	FULLWAY TECHNOLOGY WUJIANG CO., LTD.		☐
If you wish to add additional Foreign Patent Document citation information please click the Add button								Add
NON-PATENT LITERATURE DOCUMENTS								Remove

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		2024-03-18
	First Named Inventor	Lilan ZHANG	
	Art Unit	TBD	
	Examiner Name	TBD	
Attorney Docket Number		14850267COA	

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	European Extended Search Report mailed April 24, 2023 in European counterpart application EP20923314.7, 10 pages in English	☐
	2	Chinese First Office Action mailed May 25, 2022 in counterpart Chinese application CN202110727536.3, 8 pages in Chinese	☐
	3	Chinese First Office Action mailed February 19, 2021 in counterpart Chinese application CN202010140217.8, 9 pages in Chinese	☐
	4	PCT International Search Report mailed November 25, 2020 in PCT counterpart application PCT/CN2020/077638, 4 pages in Chinese	☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE	
Examiner Signature	Date Considered

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		2024-03-18
	First Named Inventor	Lilan ZHANG	
	Art Unit	TBD	
	Examiner Name	TBD	
	Attorney Docket Number	14850267COA	

CERTIFICATION STATEMENT			
Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):			
☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).			
OR			
☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).			
☐ See attached certification statement.			
☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.			
☒ A certification statement is not submitted herewith.			
SIGNATURE			
A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.			
Signature	/Timothy J. Maier/	Date (YYYY-MM-DD)	2024-03-18
Name/Print	Timothy J. Maier	Registration Number	51986
This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.			

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE
As the below named inventor, I hereby declare that: This declaration is directed to: ☐ The attached application, or ☒ United States application or PCT international application number <u>PCT/CN2020/077638</u> filed on <u>3 March 2020</u> The above-identified application was made or authorized to be made by me I believe that I am the original inventor or an original joint inventor of a claimed invention in the application. I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both. WARNING: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.	
LEGAL NAME OF INVENTOR Inventor: <u>Lilan ZHANG</u> Date (Optional): _____ Signature: <u>Zhang Lilan</u>	
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.	

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to be (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE
As the below named inventor, I hereby declare that: This declaration is directed to: ☐ The attached application, or ☒ United States application or PCT international application number <u>PCT/CN2020/077638</u> filed on <u>3 March 2020</u> The above-identified application was made or authorized to be made by me. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application. I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both. WARNING: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identify itself. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.	
LEGAL NAME OF INVENTOR Inventor: <u>Chao TANG</u> Date (Optional): _____ Signature: <u>Chao Tang</u>	
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/D1 form for each additional inventor.	

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.53. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of
Invention

ELECTROLYTE AND ELECTROCHEMICAL DEVICE

As the below named inventor, I hereby declare that:

This declaration
is directed to:



The attached application, or



United States application or PCT international application number PCT/CN2020/077638

filed on 3 March 2020

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001
by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, this record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Jianming ZHENG

Date (Optional): _____

Signature

Jianming Zheng

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 38 U.S.C. 115 and 37 CFR 1.62. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 38 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-6199 and select option 2.

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

<i>In re</i> Patent Application of: NINGDE AMPEREX TECHNOLOGY LIMITED	Confirmation No.: TBD
U.S. Patent Application No.: TBD	Art Unit: TBD
Filed: March 18, 2024	Examiner: TBD
Title: ELECTROLYTE AND ELECTROCHEMICAL DEVICE	Attorney Docket No.: 14850267COA

INFORMATION DISCLOSURE STATEMENT

March 18, 2024

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

It is respectfully requested that the references listed on the attached PTO/SB/08a form be made of record and considered with respect to the above-referenced U.S. patent application. Copies of the listed references were cited and/or filed in prior parent application Serial No. 16/970,864 filed August 18, 2020, where required, as were either statements of relevancy or any readily available partial or full English translations of pertinent portions of any non-English language reference(s). Submission of the present Information Disclosure Statement should not be taken as an admission that the cited references are legally available prior art or that the same are pertinent or material.

Respectfully submitted,

Maier & Maier, PLLC
345 South Patrick Street
Alexandria, Virginia 22314
(703) 740-8322
Customer No. 62008

/Timothy J. Maier/
Timothy J. Maier
Attorney of Record
Reg. No. 51986

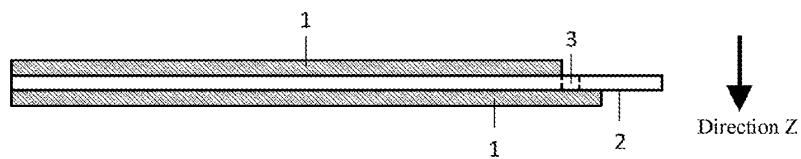


FIG. 1

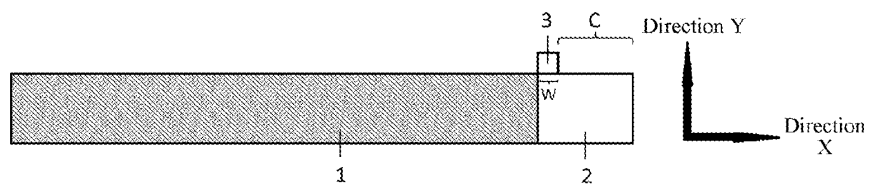


FIG. 2

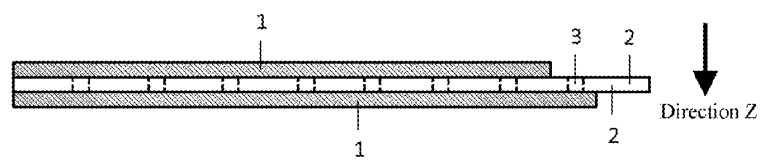


FIG. 3

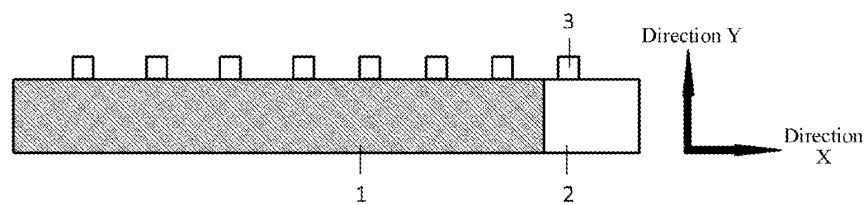


FIG. 4

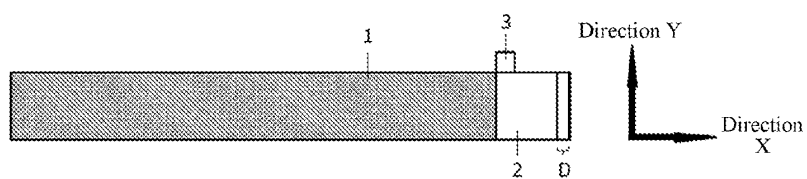


FIG. 5

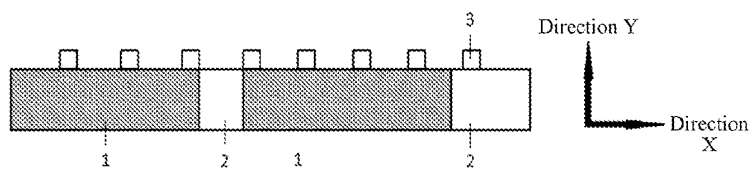


FIG. 6

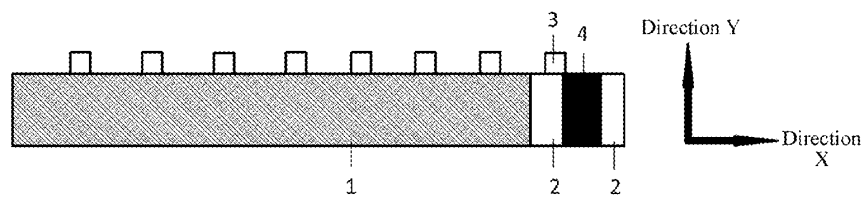


FIG. 7

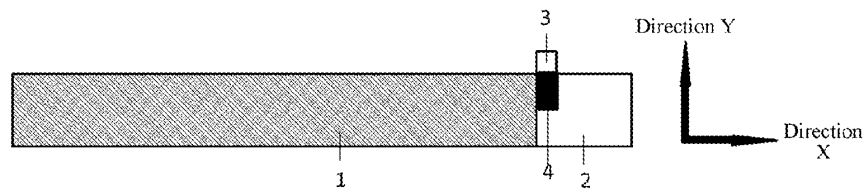


FIG. 8

UTILITY PATENT APPLICATION TRANSMITTAL (Only for new nonprovisional applications under 37 CFR 1.53(b))	Attorney Docket No.	14850267COA
	First Named Inventor	Lilan ZHANG
	Title	ELECTROLYTE AND ELECTROCHEMICAL DEVICE
	Priority Mail Express® Label No.	

APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents.	Commissioner for Patents ADDRESS TO: P.O. Box 1450 Alexandria, VA 22313-1450
--	---

1. ☐ Fee Transmittal Form (PTO/SB/17 or equivalent) 2. ☐ Applicant asserts small entity status. See 37 CFR 1.27 3. ☐ Applicant certifies micro entity status. See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent. 4. ☒ Specification [Total Pages <u>37</u>] Both the claims and abstract must start on a new page. (See MPEP § 608.01(a) for information on the preferred arrangement) 5. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets <u>5</u>] 6. ☒ Inventor's Oath or Declaration [Total Pages <u>3</u>] (including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e)) a. ☐ Newly executed (original or copy) b. ☒ A copy from a prior application (37 CFR 1.63(d)) 7. ☒ Application Data Sheet * See note below. See 37 CFR 1.76 (PTO/AIA/14 or equivalent) 8. CD-ROM or CD-R in duplicate, large table, or Computer Program (Appendix) ☐ Landscape Table on CD 9. Nucleotide and/or Amino Acid Sequence Submission (if applicable, items a. – c. are required) a. ☐ Computer Readable Form (CRF) b. ☐ Specification Sequence Listing on: i. ☐ CD-ROM or CD-R (2 copies); or ii. ☐ Paper c. ☐ Statements verifying identity of above copies	ACCOMPANYING APPLICATION PAPERS 10. ☐ Assignment Papers (cover sheet & document(s)) Name of Assignee _____ 11. ☐ 37 CFR 3.73(c) Statement ☒ Power of Attorney (when there is an assignee) 12. ☐ English Translation Document (if applicable) 13. ☒ Information Disclosure Statement (PTO/SB/08 or PTO-1449) ☐ Copies of citations attached 14. ☐ Preliminary Amendment 15. ☐ Return Receipt Postcard (MPEP § 503) (Should be specifically itemized) 16. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed) 17. ☐ Nonpublication Request Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent. 18. ☒ Other: IDS Statement _____ _____ _____
--	---

***Note:** (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

☒ The address associated with Customer Number: 62008 **OR** ☐ Correspondence address below

Name				
Address				
City	State	Zip Code		
Country	Telephone	Email		

Signature	/Timothy J. Maier/	Date	March 18, 2024
Name (Print/Type)	Timothy J. Maier	Registration No. (Attorney/Agent)	51986

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	14850267COA
		Application Number	
Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Lilan		ZHANG		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Ningde	Country of Residence ⁱ	CN		
Mailing Address of Inventor:					
Address 1		No. 1, Xingang Road, Zhangwan Town			
Address 2		Jiaocheng District			
City	Ningde, Fujian	State/Province			
Postal Code	352100	Country ⁱ	CN		
Inventor 2					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Chao		TANG		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Ningde	Country of Residence ⁱ	CN		
Mailing Address of Inventor:					
Address 1		No. 1, Xingang Road, Zhangwan Town			
Address 2		Jiaocheng District			
City	Ningde, Fujian	State/Province			
Postal Code	352100	Country ⁱ	CN		
Inventor 3					Remove
Legal Name					

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	14850267COA
		Application Number	
Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jianming		ZHENG	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Ningde	Country of Residence ⁱ		
Mailing Address of Inventor:				
Address 1	No. 1, Xingang Road, Zhangwan Town			
Address 2	Jiaocheng District			
City	Ningde, Fujian	State/Province		
Postal Code	352100	Country ⁱ	CN	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.				Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).			
☐ An Address is being provided for the correspondence Information of this application.			
Customer Number	62008		
Email Address	patent@maierandmaier.com	Add Email	Remove Email

Application Information:

Title of the Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		
Attorney Docket Number	14850267COA	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	14850267COA
		Application Number	
Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		

Publication Information:

☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐	Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.			
Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	62008		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	16970864	2020-08-18
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16970864	a 371 of international	PCT/CN2020/077638	2020-03-03
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	14850267COA
		Application Number	
Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)ⁱ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)	Remove
Additional Foreign Priority Data may be generated within this form by selecting the Add button.				Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. ☐ NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.
--

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	14850267COA
		Application Number	
Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	14850267COA
		Application Number	
Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.								
Applicant 1			Remove					
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.								
Clear								
☒ Assignee	☐ Legal Representative under 35 U.S.C. 117	☐ Joint Inventor						
☐ Person to whom the inventor is obligated to assign.	☐ Person who shows sufficient proprietary interest							
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:								
Name of the Deceased or Legally Incapacitated Inventor:								
If the Applicant is an Organization check here. ☒								
Organization Name	Ningde Amperex Technology Limited							
Mailing Address Information For Applicant:								
Address 1	No. 1, Xingang Road, Zhangwan Town							
Address 2	Jiaocheng District							
City	Ningde, Fujian	State/Province						
Country	CN	Postal Code	352100					
Phone Number		Fax Number						
Email Address								
Additional Applicant Data may be generated within this form by selecting the Add button.			Add					

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	14850267COA
		Application Number	
Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

[Remove](#)

If the Assignee or Non-Applicant Assignee is an Organization check here.



Organization Name

Ningde Amperex Technology Limited

Mailing Address Information For Assignee including Non-Applicant Assignee:**Address 1**

No. 1, Xingang Road, Zhangwan Town

Address 2

Jiaocheng District

City

Ningde, Fujian

State/Province**Countryⁱ**

CN

Postal Code

352100

Phone Number

Fax Number

Email Address

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

[Add](#)**Signature:**[Remove](#)

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature

/Timothy J. Maier/

Date (YYYY-MM-DD)

2024-03-18

First Name

Timothy J.

Last Name

Maier

Registration Number

51986

Additional Signature may be generated within this form by selecting the Add button.

[Add](#)

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	14850267COA
		Application Number	
Title of Invention	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC PAYMENT RECEIPT

APPLICATION #
18/607,737

RECEIPT DATE / TIME
03/18/2024 11:35:22 AM Z ET

ATTORNEY DOCKET #
14850267COA

Title of Invention

ELECTROLYTE AND ELECTROCHEMICAL DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	7065	FILED BY	Mark Gambriel
PATENT CENTER #	64720913	AUTHORIZED BY	Timothy Maier
CUSTOMER #	62008	FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Lilan ZHANG

Payment Information

PAYMENT METHOD
CARD / 8716

PAYMENT TRANSACTION ID
E20243HB36006342

PAYMENT AUTHORIZED BY
Mark Gambriel

PRE-AUTHORIZED ACCOUNT
505976

PRE-AUTHORIZED CATEGORY
37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.21 (Miscellaneous fees and charges)

FEE CODE	DESCRIPTION	ITEM PRICE(\$)	QUANTITY	ITEM TOTAL(\$)
1111	UTILITY PATENT APPL. SEARCH FEE	700.00	1	700.00
1011	BASIC FILING FEE - UTILITY (PAPER FILING ALSO REQUIRES NON-ELECTRONIC FILING FEE UNDER 1.16(T))	320.00	1	320.00
1311	PATENT APPL. EXAMINATION FEE	800.00	1	800.00
TOTAL AMOUNT:				\$1,820.00

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #
18/607,737

RECEIPT DATE / TIME
03/18/2024 11:35:22 AM Z ET

ATTORNEY DOCKET #
14850267COA

Title of Invention

ELECTROLYTE AND ELECTROCHEMICAL DEVICE

Application Information

APPLICATION TYPE Utility - Nonprovisional Application
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 7065

FILED BY Mark Gambriel

PATENT CENTER # 64720913

FILING DATE -

CUSTOMER # 62008

FIRST NAMED
INVENTOR Lilan ZHANG

CORRESPONDENCE
ADDRESS -

AUTHORIZED BY Timothy Maier

Documents

TOTAL DOCUMENTS: 11

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
PAT201908032US1-ADS.pdf	9	Application Data Sheet	2174 KB
PAT201908032US1-IDS Statement.pdf	1	Transmittal Letter	17 KB
PAT201908032US1- Declaration.pdf	3	Oath or Declaration filed	376 KB
PAT201908032US1-POA.pdf	2	Power of Attorney	352 KB
PAT201908032US1- Transmittal.pdf	2	Transmittal of New Application	550 KB
PAT201908032US1-IDS.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	1235 KB
PAT201908032US1- Drawings.pdf	5	Drawings-other than black and white line drawings	717 KB

PAT201908032US1- Specification- APP.TEXT.docx	37	Application body structured text document	240 KB
---	----	--	--------

Warning: The document contains OLE objects that are currently not supported. These objects may not be visible in your application documents. All artifacts (SmartArt, Drawings, Charts, etc) have been replaced with images. Document has [Balance SBCS characters and DBCS characters] option enabled and may result in reduction of pages, however, no data or text has been modified. Bookmarks were found and have been removed. Paragraph numbering is missing from the specification. Please review the specification and revise if necessary.

PAT201908032US1- Specification-Auxiliary.pdf	37	-	229 KB
PAT201908032US1- Specification-Auxiliary- SPEC.pdf	(1-31)	31	Specification 198 KB
PAT201908032US1- Specification-Auxiliary- CLM.pdf	(32-36)	5	Claims 53 KB
PAT201908032US1- Specification-Auxiliary- ABST.pdf	(37-37)	1	Abstract 18 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
PAT201908032US1-ADS.pdf	6F1D2CAF5BC79FFA4DA8A93567FA6B55D7F6DF083AC3507F EA78AD439DEB3C7D11AF759DC7D93E59BC036956DFABDA9 A26FDBD9BF0E44788958E4BC363D7A730
PAT201908032US1-IDS Statement.pdf	3CB29CC3997E538E52A4046635F1797AA04E4B87163F585892 639E83CB4F4F93969BACA21C22566AFD66F8918469564FE5B F63F12756830695ED248E545BEF47
PAT201908032US1- Declaration.pdf	E06D235336886A3205F72FE1602F191390E6D076D52529DD0F 83CA70374E0AAB20881FE043D4A3B77B19DE5840D76D42FE8 44137E8E4BBC977E1FDE27E2B7A2B
PAT201908032US1-POA.pdf	D5C55C6DBB003462AED62FD3826F541AB6C2C384156CFC83 4BA58A28AF8F4947F637925D09F527423FBB516E524C346D72 2B6BAFC144301E6510CB8057F660ED
PAT201908032US1- Transmittal.pdf	D41F5FE499C9528F69A9FD87C7158D8917E531A97CCE6D38A ABDA37886A3E807C6C23DC98ED24C1B456BD AFF57FDABF4 A3E68547C433C87A46150432630E35AC

PAT201908032US1-IDS.pdf	AB62EDF99DABC7640480664D8042744E12B6E2B3327D121C6 AD3F73FD01DE4DA1D2441A5837B2E06D0C473380B0FDDDB4 51C34EE3D478F43F7BB660ACBB198FC
PAT201908032US1- Drawings.pdf	FA8AEB79F718CFFA3AC4245FFBABF3E67663007565320112B B49223FF39A2B9FCC2FD551A1CA257694003476BB25085BB5 CFF7FA98570BDCDB4AD0BF3CB4C29D
PAT201908032US1- Specification-APP.TEXT.docx	B2EC35A388B20DC06228A9854C345EE0B549F348F073623CB A249388B62AEC8C6F661E7AC43AB014498E75DD49875834EB 38D22E64FE3499739F04882C9CC80C
PAT201908032US1- Specification-Auxiliary.pdf	0E7ADCBA18D72EDD7E24C4E0EBE4B24B8658957933690E68 3194389A81ACA0F352645BE9A5FF4834BA56CC5F600EA65AF 764CF6C9E13004037D1DE178AA46AC7
PAT201908032US1- Specification-Auxiliary- SPEC.pdf	A05EB6E00709BA1A059746B026D69212C5C2C9C34CF4F7C6F A96C6AB527E6B95537904CAC467000E60AB71DA3FAD18A505 697B0B293C6769207C64899330652E
PAT201908032US1- Specification-Auxiliary-CLM.pdf	F5F4CD03709BCCF89D7B1E0C9797AC9A766F753C5ED08C3E 5860FD071B982CE70EB33AEA93518B858F37A8494EDF5F1FC FB7039AE1F15F31BAB652E1F650DEBD
PAT201908032US1- Specification-Auxiliary- ABST.pdf	7EA95719639B022AE564F6331FC8EFCCF2D562154C6D93C82 BF463E86D53F6D9F87DFDAD8F13D7EA11848906E738A7362B 948143ABF7FA49A19E2F56550E0577

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

ELECTROLYTE AND ELECTROCHEMICAL DEVICE**CROSS REFERENCE TO RELATED APPLICATIONS**

The present application is a continuation application of US Application 16/970864, which is a National Stage application of International Application No. PCT/CN2020/077638, filed on Mar. 3, 2020, the contents of which are incorporated herein by reference in its entirety.

TECHNICAL FIELD

The present application relates to the technical field of energy storage, and more particularly to an electrolyte and an electrochemical device including the electrolyte.

BACKGROUND

Electrochemical devices, such as lithium-ion batteries, have the advantages of high energy density, high working voltage, low self-discharging rate, long cycle life, no pollution and the like, and thus have been widely applied to the fields of computers, intelligent wearable devices, smart phones, unmanned aerial vehicles, electric vehicles and the like. With the development of modern information technology and the expansion of the application range of lithium-ion batteries, there are higher requirements on energy density of lithium-ion batteries in the art.

There are many factors affecting the energy density of lithium-ion batteries. At present, improving a charging cut-off voltage of the lithium-ion battery is one of the effective measures for improving the energy density, but the voltage improvement causes deterioration of positive electrode stability. How to solve the above-mentioned problem to increase the energy density of lithium-ion batteries has become an urgent problem to be solved in the art.

SUMMARY

Through research, the inventor discovers that although nitrile additives may effectively improve stability of positive electrode and thus significantly improve properties such as cycle performance of electrochemical devices, the nitrile additives may cause copper dissolution from current collector of negative electrode, thus influencing stability of negative electrode, and particularly, battery self-discharging or even safety problems may occur when copper ions are dissolved at welding position of tab.

The present application provides an electrochemical device capable of meeting high-voltage

cycle stability, solving the self-discharging problem of electrochemical devices at high voltage, and improving safety characteristics.

In some embodiments, the present application provides an electrochemical device, including a positive electrode, a negative electrode, a separator and an electrolyte, wherein the electrolyte includes a nitrile compound, and the mass percentage of the nitrile compound in the electrolyte is A%.

The negative electrode includes a current collector, and the current collector includes a first region and a second region;

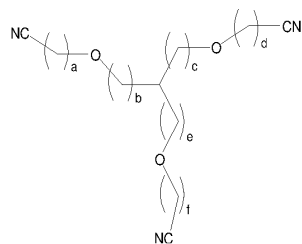
the first region is provided with a negative electrode active substance layer;

the second region does not include a negative electrode active substance layer;

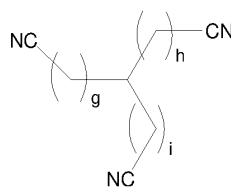
the area of the second region accounts for B% of the surface area of the current collector; and

$A \times B < 600$.

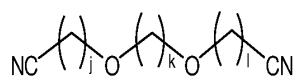
In some embodiments, the nitrile compound includes at least one of the following: a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V or a compound of Formula VI:



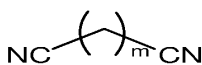
Formula I,



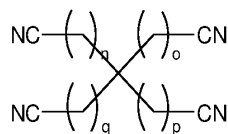
Formula II,



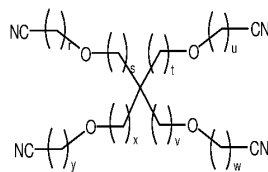
Formula III,



Formula IV,



Formula V, and

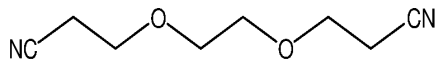


Formula VI,

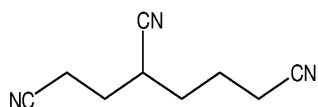
wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is an integer independently selected from

0 to 5; and the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%.

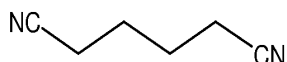
In some embodiments, the nitrile compound includes at least one of the following compounds:



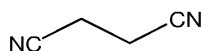
Compound 1,



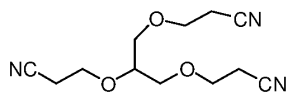
Compound 2,



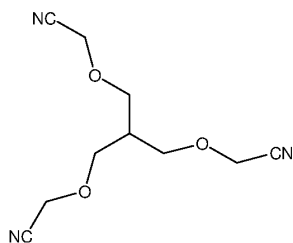
Compound 3,



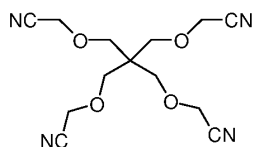
Compound 4,



Compound 5,



Compound 6, or



Compound 7.

In some embodiments, the negative electrode includes a tab. The tab is formed through being connected to the second region by welding, and $A \times B < 210$.

In some embodiments, the negative electrode includes at least one tab, and the tab is formed by cutting the current collector. The tab includes a region not coated with a negative electrode active substance layer, and $A \times B < 500$.

In some embodiments, at least one of the second region is positioned at an edge of the current collector, a distance between the tab closest to the edge of the current collector and the edge of the current collector is C, and $0 \leq C/\text{tab width} \leq 50$.

In some embodiments, at least one of the second region is positioned at the edge of the current collector, and an edge of the second region positioned at the edge of the current collector is either folded or not folded, wherein if the edge of the second region positioned at the edge of the current collector is folded, the width of the folded region is D, and $0.1 \leq D/\text{tab width} \leq 20$.

In some embodiments, the current collector is a copper foil, and the copper foil has one or more of the following properties:

- a copper purity of $\geq 99.5\%$,
- a thickness of 3 microns to 15 microns,
- a weight per unit area of 30 g/m^2 to 150 g/m^2 ,
- a tensile strength of $\geq 20 \text{ kg/mm}^2$, and
- an elongation rate of $\geq 1.5\%$.

In some embodiments, the second region is optionally covered by a substance capable of being adhered onto the second region.

In some embodiments, a portion of the tab is optionally covered by a substance capable of being adhered onto the portion of the tab.

In some embodiments, the electrolyte further includes an additive. The additive includes at least one of the following: 1,3-propane sultone, fluoroethylene carbonate, vinylene carbonate, 2,4-butane sultone, 1,4-butane sultone, methylene methanedisulfonate, ethylene sulfate, succinic anhydride, ethoxy(pentafluoro)cyclotriphosphazene, 1,3-dioxane, or propenyl-1,3-sultone.

In some embodiments, the electrolyte further includes an anion, and the anion includes at least one of the following: Cl^- , Br^- , SO_4^{2-} , CO_3^{2-} or F^- , and the content of the anion in the electrolyte is less than or equal to 1000 ppm.

In another aspect, the present application provides an electronic device, and the electronic device includes any of the electrochemical devices above.

Additional aspects and advantages of the embodiments of the present application will be described or shown in the following description or interpreted by implementing the embodiments of the present application.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of a current collector of a negative electrode according to an embodiment of the present application.

FIG. 2 is a side view of the current collector in FIG. 1 in direction Z.

FIG. 3 is a top view of a current collector of a negative electrode according to another embodiment of the present application.

FIG. 4 is a side view of the current collector in FIG. 3 in direction Z.

FIG. 5 is a side view of a current collector of a negative electrode according to another embodiment of the present application.

FIG. 6 is a side view of a current collector of a negative electrode according to another embodiment of the present application.

FIG. 7 is a side view of a current collector of a negative electrode according to another embodiment of the present application.

FIG. 8 is a top view of a current collector of a negative electrode according to another embodiment of the present application.

DETAILED DESCRIPTION

The embodiments of the present application will be described in detail below. The embodiments of the present application should not be interpreted as limitations to the protection scope of the present application. Unless otherwise expressly indicated, the following terms used herein have the meanings indicated below.

As used in the present application, terms "approximately", "substantially", "essentially", and "about" are used for describing and explaining a small variation. When being used in combination with an event or circumstance, the term may refer to an example in which the event or circumstance occurs precisely, and an example in which the event or circumstance occurs approximately. For example, when being used in combination with a value, the term may refer to a variation range of less than or equal to $\pm 10\%$ of the value, for example, less than or equal to $\pm 5\%$, less than or equal to $\pm 4\%$, less than or equal to $\pm 3\%$, less than or equal to $\pm 2\%$, less than or equal to $\pm 1\%$, less than or equal to $\pm 0.5\%$, less than or equal to $\pm 0.1\%$, or less than or equal to $\pm 0.05\%$, and then it may be regarded that two values are "substantially" the same.

In addition, sometimes, a quantity, a ratio, and another value are presented in a range format in

the present application. It should be appreciated that such range formats are for convenience and conciseness, and should be flexibly understood as including not only values explicitly specified to range constraints, but also all individual values or sub-ranges within the ranges, like explicitly specifying each value and each sub-range.

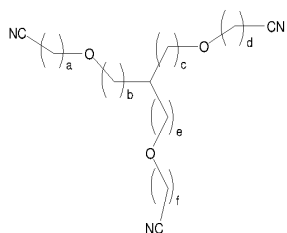
In the detailed description and the claims, a list of items connected by the term "at least one of" may mean any one of the listed items. For example, if items A and B are listed, then the phrase "one of A and B" means only A or only B. In another example, if items A, B, and C are listed, then the phrase "one of A, B and C" means only A; only B; or only C. The item A may include a single component or multiple components. The item B may include a single component or multiple components. The item C may include a single component or multiple components.

In the detailed description and the claims, a list of items connected by the term "at least one of" may mean any combination of the listed items. For example, if items A and B are listed, then the phrase "at least one of A and B" or "at least one of A or B" means only A; only B; or A and B. In another example, if items A, B and C are listed, then the phrases "at least one of A, B and C" or "at least one of A, B or C" mean only A; or only B; only C; A and B (excluding C); A and C (excluding B); B and C (excluding A); or all of A, B and C. The item A may include a single component or multiple components. The item B may include a single component or multiple components. The item C may include a single component or multiple components.

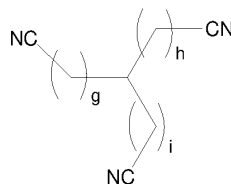
As used herein, the content of each ingredient in an electrolyte is obtained on the basis of the total weight of the electrolyte.

1. Electrolyte

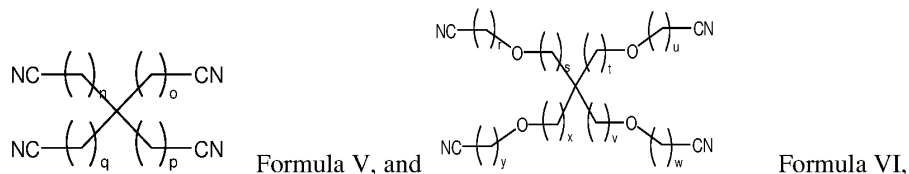
In some embodiments, the electrolyte of the present application includes a nitrile compound, and the nitrile compound includes at least one of a compound shown as Formula I, a compound shown as Formula II, a compound shown as Formula III, a compound shown as Formula IV, a compound shown as Formula V or a compound shown as Formula VI:



Formula I,

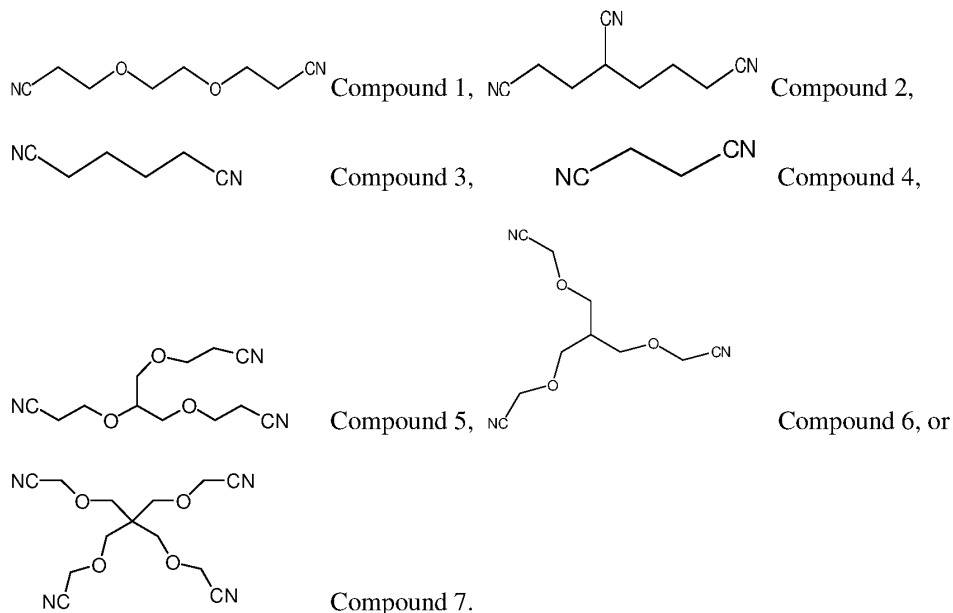


Formula II,



wherein each of a, d, f, j, k, l, m, r, u, w and y is independently selected from 1, 2, 3, 4 or 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is independently selected from 0, 1, 2, 3, 4 or 5; the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%, 0.3% to 8%, 1% to 6%, or 3% to 4%; and in some embodiments, A% is about 0.5%, about 1.5%, about 2.5%, about 3.5%, about 4.5%, about 5.5%, about 6.5%, about 7.5%, about 8.5% or about 9.5%.

In some embodiments, the nitrile compound includes at least one of the following compounds:



In some embodiments, in order to further improve performance of a lithium-ion battery, the electrolyte further includes one or more of the following additives: 1,3-propane sultone (PS), fluoroethylene carbonate (FEC), vinylene carbonate (VC), 2,4-butane sultone, 1,4-butane sultone, methylene methanedisulfonate (MMDS), ethylene sulfate (DTD), succinic anhydride (SA), ethoxy(pentafluoro)cyclotriphosphazene and 1,3-dioxane (DOX), or propenyl-1,3-

sultone.

In some embodiments, in order to inhibit copper dissolution caused by the electrolyte containing the nitrile compound, the electrolyte may further contain an anion, such as at least one of the inorganic anions Cl^- , Br^- , SO_4^{2-} , CO_3^{2-} or F^- . In some embodiments, the content of the anion in the electrolyte is less than or equal to 1000 ppm.

In some embodiments, the electrolyte further includes a lithium salt and an organic solvent.

In some embodiments, the lithium salt is one or more selected from inorganic lithium salts and organic lithium salts. In some embodiments, the lithium salt contains at least one of a fluorine element, a boron element or a phosphorus element. In some embodiments, the lithium salt is selected from one or more of the following lithium salts: at least one of lithium hexafluorophosphate (LiPF_6), bistrifluoromethanesulfonimide lithium salt (LiTFSI), lithium bis(fluorosulfonyl)imide (LiFSI), lithium bis(oxalate)borate (LiBOB), lithium difluoro(oxalato)borate (LiDFOB), lithium hexafluoroarsenate (LiAsF_6), lithium perchlorate (LiClO_4) and lithium trifluoromethanesulfonate (LiCF_3SO_3).

In some embodiments, the concentration of the lithium salt is 0.5 M to 1.5 M. In some embodiments, the concentration of the lithium salt is 0.8 M to 1.2 M.

The organic solvent includes a cyclic ester and a chain ester; the cyclic ester is at least one selected from ethylene carbonate (EC), propylene carbonate (PC), γ -butyrolactone (BL) and 2,3-butylene carbonate; and the chain ester is at least one selected from dimethyl carbonate (DMC), diethyl carbonate (DEC), ethyl methyl carbonate (EMC), propylene carbonate, methyl formate (MF), ethyl formate (EF), ethyl acetate (EA), ethyl propionate (EP), propyl propionate (PP), methyl propionate, propyl acetate, methyl butyrate and ethyl butyrate.

2. Electrochemical device

The electrochemical device of the present application includes any device in which an electrochemical reaction occurs, and specific examples of the electrochemical device includes all kinds of primary batteries, secondary batteries, fuel cells, solar cells, or capacitors. Particularly, the electrochemical device is a lithium secondary battery including a lithium metal secondary battery, a lithium-ion secondary battery, a lithium polymer secondary battery or a lithium-ion polymer secondary battery. In some embodiments, the electrochemical device of the present application is an electrochemical device including a positive electrode with a positive electrode active substance capable of absorbing and releasing metal ions and a negative electrode with a negative electrode active substance capable of absorbing and releasing metal

ions, and is characterized by including any of the above electrolytes of the present application.

Electrolyte

The electrolyte used in the electrochemical device of the present application is any of the above electrolytes of the present application.

Negative Electrode

In the electrochemical device according to the present application, the negative electrode includes a current collector and a negative electrode active material layer arranged on the current collector. The negative electrode active material layer includes a negative electrode active material. The specific type of the negative electrode active material is not particularly limited, and may be selected according to requirements.

The negative electrode may be prepared according to a preparation method known in the art. For example, the negative electrode may be obtained through the following method: mixing an active material, a conductive material and a binder in a solvent to prepare an active material composition, and applying the active material composition to the current collector.

The negative electrode active material includes a material for reversible intercalation/deintercalation of lithium ions. In some embodiments, the material for reversible intercalation/deintercalation of lithium ions includes a carbon material. In some embodiments, the carbon material may be any carbon-based negative electrode active material commonly used in lithium-ion rechargeable batteries. In some embodiments, the carbon material includes, but is not limited to, crystalline carbon, amorphous carbon, or a mixture thereof. The crystalline carbon may be amorphous, plate-shaped, platelet-shaped, spherical or fibrous natural graphite or artificial graphite. The amorphous carbon may be soft carbon, hard carbon, carbonized mesophase pitch, calcined coke, and the like.

In some embodiments, the negative electrode active material layer includes a negative electrode active material. In some embodiments, the negative electrode active material includes, but is not limited to, lithium metal, structured lithium metal, natural graphite, artificial graphite, mesocarbon microbead (MCMB), hard carbon, soft carbon, silicon, silicon-carbon composite, Li-Sn alloy, Li-Sn-O alloy, Sn, SnO, SnO₂, lithiated TiO₂-Li₄Ti₅O₁₂ of a spinel structure, Li-Al alloy or any combination thereof.

In some embodiments, the negative electrode active material layer may include a binder, and optionally includes a conductive material. The binder increases binding of negative electrode

active material particles to each other and binding of the negative electrode active material to the current collector. In some embodiments, the binder includes, but is not limited to, polyvinyl alcohol, carboxymethyl cellulose, hydroxypropyl cellulose, diacetyl cellulose, polyvinyl chloride, carboxylated polyvinyl chloride, polyvinyl fluoride, an ethylene-oxide-containing polymer, polyvinylpyrrolidone, polyurethane, polytetrafluoroethylene, poly(1,1-difluoroethylene), polyethylene, polypropylene, styrene butadiene rubber, acrylated styrene butadiene rubber, epoxy resin, nylon, etc.

In some embodiments, the conductive material includes, but is not limited to, a carbon-based material, a metal-based material, a conductive polymer or a mixture thereof. In some embodiments, the carbon-based material is selected from natural graphite, artificial graphite, carbon black, acetylene black, Ketjen black, carbon fiber or any combination thereof. In some embodiments, the metal-based material is selected from metal powder, metal fiber, copper, nickel, aluminum and silver. In some embodiments, the conductive polymer is a polyphenylene derivative.

The current collector of the negative electrode in the electrochemical device according to the present application may be selected from a copper foil, a nickel foil, a stainless steel foil, a titanium foil, nickel foam, copper foam, a polymer substrate coated with a conductive metal, and combinations thereof. In some embodiments, the current collector includes a copper foil.

In some embodiments, the copper foil is formed through electrolysis or calendaring. Its purity is greater than or equal to 99.5%, and the total content of trace elements such as nickel, zinc and chromium is less than or equal to 0.5 wt%.

In some embodiments, the copper foil has one or more of the following properties:

- a copper purity of $\geq 99.5\%$;
- a thickness of 3 microns to 15 microns, for example, the thickness is about 4 microns, about 5 microns, about 6 microns, about 7 microns, about 8 microns, about 9 microns, about 10 microns, about 11 microns, about 12 microns, about 13 microns, or about 14 microns;
- a weight per unit area of 30 g/m^2 to 150 g/m^2 , for example, the weight in the unit area is about 50 g/m^2 , about 70 g/m^2 , about 90 g/m^2 , about 110 g/m^2 , or about 130 g/m^2 ;
- a tensile strength of $\geq 20 \text{ kg/mm}^2$, for example, the tensile strength $\geq 30 \text{ kg/mm}^2$, $\geq 40 \text{ kg/mm}^2$, or $\geq 50 \text{ kg/mm}^2$; and
- an elongation rate of $\geq 1.5\%$, for example, the elongation rate $\geq 2\%$, $\geq 2.5\%$, $\geq 3\%$, $\geq 3.5\%$,

or $\geq 4\%$.

In some embodiments, the copper foil is formed through electrolysis, its purity is greater than or equal to 99.5%, its thickness is about 6 microns, the tensile strength is greater than or equal to 30 kg/mm², and the elongation rate is greater than or equal to 3%.

In some embodiments, the copper foil has anti-corrosive properties, for example, no obvious color change occurs after the copper foil is soaked in an electrolyte prepared from ethylene carbonate (EC), propylene carbonate (PC) and diethyl carbonate (DEC) in a mass ratio of 3:1:7, and a LiPF₆ content being 1 mol/L at 45°C for about 48 hours.

The electrochemical device in some embodiments includes a positive electrode, a negative electrode, a separator and an electrolyte, wherein the electrolyte includes a nitrile compound. The mass percentage of the nitrile compound in the electrolyte is A%. The negative electrode includes a current collector. The current collector includes a first region and a second region, wherein the first region is provided with a negative electrode active substance layer; the second region does not include a negative electrode active substance layer. The area of the second region accounts for B% of the surface area of the current collector, and the value of A times B is smaller than 600, for example, the value of A times B is smaller than 550, smaller than 500, smaller than 450, smaller than 400, smaller than 350, smaller than 300, smaller than 250, smaller than 200, smaller than 150, smaller than 100, smaller than 50, smaller than 30, smaller than 15, or smaller than 5.

In some embodiments, the negative electrode includes a tab. The tab is formed through being connected to the second region by welding, and the value of A times B is smaller than 210. For example, the value of A times B is smaller than 200, smaller than 150, smaller than 100, smaller than 50, smaller than 30, smaller than 15, or smaller than 10.

FIG. 1 and FIG. 2 show schematic diagrams of a current collector of a negative electrode according to an embodiment of the present application. The current collector includes a first region 1 and a second region 2, wherein the first region is provided with a negative electrode active substance layer (as shown by gray region in the figure); and the second region does not include a negative electrode active substance layer. The negative electrode is provided with a tab 3, and the tab is formed by being connected to the second region through welding.

As shown in FIG. 2, in some embodiments, at least one second region is positioned at an edge of the current collector, wherein a distance between the tab closest to the edge of the current collector and the edge of the current collector is C, the width of the tab is W, and the range of "C/W (i.e., the ratio of C to W) is 0 to 50, for example, 5 to 40, 10 to 30, 15 to 40, or 20 to 30.

In some embodiments, the negative electrode is provided with 1 to 150 tabs, for example, the number of the tabs is 3, 5, 7, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 120, 130, or 140; the tabs are formed by cutting the current collector; the tabs include regions not coated with the negative electrode active substance layer; the value of A times B is smaller than about 500; and for example, the value of A times B is smaller than 450, smaller than 400, smaller than 350, smaller than 300, smaller than 250, smaller than 200, smaller than 150, smaller than 100, smaller than 50, smaller than 30, smaller than 15 or smaller than 10.

FIG. 3 and FIG. 4 show schematic diagrams of a current collector of a negative electrode of another embodiment of the present application. The current collector includes a first region 1 and a second region 2, wherein the first region is provided with a negative electrode active substance layer; the second region does not include a negative electrode active substance layer. The negative electrode is provided with a plurality of tabs 3. The tabs are formed by cutting the current collector, and the tab includes a region not coated with the negative electrode active substance layer.

As shown in FIG. 5, in some embodiments, at least one second region is positioned at the edge of the current collector, and an edge of the second region positioned at the edge of the current collector is either folded or not folded. When the edge of the second region positioned at the edge of the current collector is folded, the width of the folded region is D, the width of the tab is W, and the range of "D/W" (i.e., the ratio of D to W) is 0.1 to 20, for example, 2 to 18, 4 to 16, 6 to 14, 8 to 12, or 9 to 10.

As shown in FIG. 6, in some embodiments, at least one second region is positioned at the edge of the current collector; and the negative electrode further includes one or more second regions positioned in the middle of the current collector, wherein the one or more second regions do not include a negative electrode active substance layer.

In some embodiments, in order to reduce the surface area of the second region as much as possible, the second region is optionally covered by a substance capable of being bond onto the second region. For example, as shown in FIG. 7, a part of the second region is covered by, for example but not limited to, a polymer adhesive tape 4.

In some embodiments, a position of the tab is optionally covered by a substance capable of being adhered onto the position of the tab. For example, as shown in FIG. 8, in order to reduce copper ion dissolution in a welding position of the tab and the second region, the welding part of the tab may be covered by, for example but not limited to, a polymer adhesive tape.

In the negative electrode of the present application, the first region (i.e., the region provided

with the negative electrode active substance layer) may be positioned on an upper surface, on a lower surface, or on both the upper and lower surfaces of the current collector of the negative electrode; the second region may be positioned at the edge and/or the inside of the current collector of the negative electrode; and the second region further includes a tab-welding position, a tab region formed through cutting, and an edge folded region.

Positive Electrode

A material of the positive electrode used in the electrochemical device of the present application may be prepared by using materials, structures, and manufacturing methods known in the art. In some embodiments, techniques recorded in US9812739B may be used for preparing the positive electrode of the present application, which is incorporated into the present application by reference in its entirety.

In some embodiments, the positive electrode includes a current collector and a positive electrode active material layer positioned on the current collector. A positive electrode active material includes at least one lithiated intercalation compound for reversible intercalation/deintercalation of lithium ions. In some embodiments, the positive electrode active material includes a composite oxide. In some embodiments, the composite oxide contains lithium and at least one element selected from cobalt, manganese and nickel.

In some embodiments, the positive electrode active material is selected from one or more of a lithium cobalt oxide, lithium manganate, a lithium nickel oxide or a lithium nickel manganese cobalt ternary material. The negative electrode active material contains silicon or silicon-oxygen materials, and may also be optionally selected from any of negative electrode materials capable of realizing deintercalation of lithium, such as graphite, hard carbon and mesocarbon microbeads.

In some embodiments, the positive electrode active material may be provided with a coating on the surface, or may be mixed with another compound with a coating. The coating may include at least one coating element compound selected from an oxide of a coating element, a hydroxide of the coating element, an oxyhydroxide of the coating element, an oxycarbonate of the coating element and a hydroxycarbonate of the coating element. The compound used for the coating may be amorphous or crystalline.

In some embodiments, the coating element contained in the coating may include Mg, Al, Co, K, Na, Ca, Si, Ti, V, Sn, Ge, Ga, B, As, Zr or any combination thereof. The coating may be applied by any method as long as the method does not adversely affect the performance of the positive electrode active material. For example, the method may include any coating method

known in the art, such as spray coating and dipping.

The positive electrode active material layer further includes a binder, and optionally includes a conductive material. The binder increases binding of positive electrode active material particles to each other and binding of the positive electrode active material and the current collector.

In some embodiments, the binder includes, but is not limited to, polyvinyl alcohol, hydroxypropyl cellulose, diacetyl cellulose, polyvinyl chloride, carboxylated polyvinyl chloride, polyvinyl fluoride, an ethylene-oxide-containing polymer, polyvinylpyrrolidone, polyurethane, polytetrafluoroethylene, poly(1,1-difluoroethylene), polyethylene, polypropylene, styrene butadiene rubber, acrylated styrene butadiene rubber, epoxy resin, nylon, etc.

In some embodiments, the conductive material includes, but is not limited to, a carbon-based material, a metal-based material, a conductive polymer and a mixture thereof. In some embodiments, the carbon-based material is selected from natural graphite, artificial graphite, carbon black, acetylene black, Ketjen black, carbon fiber or any combination thereof. In some embodiments, the metal-based material is selected from metal powder, metal fiber, copper, nickel, aluminum and silver. In some embodiments, the conductive polymer is a polyphenylene derivative.

In some embodiments, the current collector may be aluminum, but is not limited thereto.

The positive electrode may be prepared by a preparation method known in the art. For example, the positive electrode may be obtained by the following method: mixing the active material, the conductive material and the binder in a solvent to prepare an active material composition, and applying the active material composition to the current collector. In some embodiments, the solvent may include N-methylpyrrolidone and the like, but is not limited thereto.

In some embodiments, the positive electrode is prepared by forming a positive electrode material on the current collector by using a positive electrode active substance layer including lithium-transition metal compound powder and an adhesive.

In some embodiments, the positive electrode active substance layer may be generally prepared through the following operation: performing dry mixing on the positive electrode material and the adhesive (and a conductive material, a thickener, etc., used if needed) to form flakes, and pressing the obtained flakes on the current collector of the positive electrode; or dissolving or dispersing the materials in a liquid medium to form slurry, applying the slurry to the current collector of the positive electrode, and performing drying. In some embodiments, the material

of the positive electrode active substance layer includes any material known in the art.

Separator

In some embodiments, the electrochemical device of the present application is provided with a separator between the positive electrode and the negative electrode to prevent short circuit. The material and shape of the separator used in the electrochemical device of the present application are not particularly limited, and may be any relevant techniques disclosed in the prior art. In some embodiments, the separator includes a polymer or an inorganic material and the like formed by a material stable in the electrolyte of the present application.

For example, the separator may include a substrate layer and a surface treatment layer. The substrate layer is a nonwoven fabric of a porous structure, a film or a composite film, and the material of the substrate layer is at least one selected from polyethylene, polypropylene, polyethylene terephthalate and polyimide. Specifically, a porous polypropylene film, a porous polyethylene film, a polypropylene nonwoven fabric, a polyethylene nonwoven fabric, or a porous polypropylene-polyethylene-polypropylene composite film may be selected and used. The substrate layer may be one layer or multiple layers. When the substrate layers are multiple layers, composition of polymers of different substrate layers may be identical or different, and weight-average molecular weights are different; and when the substrate layers are multiple layers, shutdown temperatures of the polymers of different substrate layers are different.

A surface treatment layer is arranged on at least one surface of the substrate layer, and the surface treatment layer may be a polymer layer or an inorganic material layer, or may be a layer formed by mixing a polymer and an inorganic material.

The inorganic material layer includes inorganic particles and an adhesive. The inorganic particles are selected from one or a combination of several of aluminum oxide, silicon oxide, magnesium oxide, titanium oxide, hafnium oxide, tin oxide, cerium oxide, nickel oxide, zinc oxide, calcium oxide, zirconium oxide, yttrium oxide, silicon carbide, boehmite, aluminum hydroxide, magnesium hydroxide, calcium hydroxide and barium sulfate. The adhesive is selected from one or a combination of several of polyvinylidene fluoride, vinylidene fluoride-hexafluoropropylene copolymers, polyamide, polyacrylonitrile, polyacrylate, polyacrylic acid, polyacrylate, polyvinylpyrrolidone, polyvinyl ether, polymethyl methacrylate, polytetrafluoroethylene and polyhexafluoropropylene. The polymer layer includes a polymer, and the material of the polymer includes at least one of polyamide, polyacrylonitrile, acrylate polymers, polyacrylic acid, polyacrylate, polyvinylpyrrolidone, polyvinyl ether, polyvinylidene fluoride or poly(vinylidene fluoride-hexafluoropropylene).

3. Application

The electrochemical device according to embodiments of the present application has improved cycle performance and high-temperature stability characteristics under an over-discharge condition, and is suitable to be used in various electronic devices.

The purpose of the electrochemical device of the present application is not particularly limited, and the electrochemical device can be used for various known purposes, for example, a notebook computer, a pen input computer, a mobile computer, an e-book player, a portable phone, a portable fax machine, a portable copy machine, a portable printer, stereo headphones, a video recorder, a liquid crystal display television, a portable cleaner, a portable CD player, a mini disk, a transceiver, an electronic notebook, a calculator, a memory card, a portable recorder, a radio, a backup power supply, a motor, a car, a motorcycle, a power bicycle, a bicycle, a lighting fixture, a toy, a game console, a clock, an electric tool, a flash lamp, a camera, a large household storage battery or a lithium-ion capacitor, etc.

Examples

Hereinafter, the present application will be specifically illustrated by way of examples and comparative examples. However, the present application is not limited thereto as long as they do not deviate from the spirit of the present application.

1. Preparation of lithium-ion battery

(1) Preparation of negative electrode

(i) Negative electrode with tab formed by welding

Artificial graphite powder, sodium carboxymethylcellulose (CMC) and styrene butadiene rubber were dissolved in water according to a mass ratio of 96:2:2 to obtain a negative electrode slurry through sufficient mixing and stirring; the negative electrode slurry was uniformly applied onto a specific region of a 12 micron-thick copper foil of a current collector of a negative electrode; baking was performed at 120°C for 1 hour to obtain a negative electrode active material layer; and then, the negative electrode was obtained through compaction, splitting, and tab-welding.

(ii) Negative electrode with tab formed by cutting

Artificial graphite powder, sodium carboxymethylcellulose (CMC) and styrene butadiene rubber were dissolved in water according to a mass ratio of 96:2:2 to obtain a negative electrode

slurry through sufficient mixing and stirring; the negative electrode slurry was uniformly applied onto a specific region of a 12 micron-thick copper foil of a current collector of a negative electrode; baking was performed at 120°C for 1 hour to obtain a negative electrode active material layer; and then, the negative electrode was obtained through compaction, tab-cutting, and splitting.

(iii) Preparation method of negative electrode (Example 59) with polymer adhesive tape on second region of negative electrode

Artificial graphite powder, sodium carboxymethylcellulose (CMC) and styrene butadiene rubber were dissolved in water according to a mass ratio of 96:2:2 to obtain negative electrode slurry through sufficient mixing and stirring; the negative electrode slurry was uniformly applied onto a specific region of a 12 micron-thick copper foil of a current collector of a negative electrode; baking was performed at 120°C for 1 hour to obtain a negative electrode active material layer; and then, the negative electrode was obtained through compaction, splitting, tab-welding, and sticking of a polymer adhesive tape made of acrylic ester onto a second region (i.e., the region not coated with the negative electrode slurry).

(iv) Preparation method of negative electrode (Example 60) with polymer adhesive tape at welding position of tab

Artificial graphite powder, sodium carboxymethylcellulose (CMC) and styrene butadiene rubber were dissolved in water according to a mass ratio of 96:2:2 to obtain a negative electrode slurry through sufficient mixing and stirring; the negative electrode slurry was uniformly applied onto a specific region of a 12 micron-thick copper foil of a current collector of a negative electrode; baking was performed at 120°C for 1 hour to obtain a negative electrode active material layer; and then, the negative electrode was obtained through compaction, splitting, tab-welding, and sticking of a polymer adhesive tape made of acrylic ester onto a welding region of a tab.

(2) Preparation of positive electrode

(i) Positive electrode with tab formed by welding

A positive electrode active material of lithium cobalt oxide (molecular formula: LiCoO_2), an adhesive of polyvinylidene fluoride (PVDF) and conductive graphite (Super-P) were dissolved in N-methylpyrrolidone (NMP) according to a mass ratio of 96:2:2 to obtain a positive electrode slurry through uniform mixing. The positive electrode slurry was uniformly applied onto an aluminum foil (having a thickness of about 12 micron) that acts as the current collector of the

positive electrode. A positive electrode active material layer was obtained after baking at 120°C for 1 hour, and then, the positive electrode was obtained through compaction, tab-welding and splitting.

(ii) Positive electrode with tab formed by cutting

A positive electrode active material of lithium cobalt oxide (molecular formula: LiCoO_2), an adhesive of polyvinylidene fluoride (PVDF) and conductive graphite (Super-P) were dissolved in N-methylpyrrolidone (NMP) according to a mass ratio of 96:2:2 to obtain a positive electrode slurry through uniform mixing. The positive electrode slurry was uniformly applied onto a 12 micron-thick aluminum foil that acts as the current collector of the positive electrode. A positive electrode active material layer was obtained after baking at 120°C for 1 hour, and then, the positive electrode was obtained through compaction, tab-cutting and splitting.

(3) Preparation of electrolyte

In a dry argon gas atmosphere glovebox, ethylene carbonate (EC), propylene carbonate (PC) and diethyl carbonate (DEC) were mixed according to a mass ratio of 3:1:7; LiPF_6 was added as a lithium salt, specific types and quantities of additives (the types and the quantities of added substances were shown in Table 1, and the content of each ingredient in the electrolyte was obtained on the basis of the total weight of the electrolyte) were added. The concentration of LiPF_6 in the electrolyte was about 1 mol/L.

(4) Preparation of separator

A polypropylene separator having a thickness of about 12 microns was selected.

(5) Preparation of lithium-ion battery

The positive electrode, the separator and the negative electrode were sequentially stacked, so that the separator was positioned between the positive electrode and the negative electrode to achieve an isolation effect. Then, the obtained structure was wound and charged into an aluminum foil packaging bag. After baking at 80°C to remove water, a corresponding electrolyte was injected. Through work procedures of vacuum encapsulation, still standing, formation, shaping and the like, a lithium-ion battery was obtained.

2. Test on copper foil used as current collector of negative electrode

Copper foil thickness test: An average value was taken after five points were measured by a micrometer.

Mass per unit area: The copper foil was cut into 100mm×100 mm wide flakes and weighed, for calculating the mass per unit area. Mass per unit area=weight/area.

Tensile strength test: A tensile testing machine was used for testing. The length of a test sample was 200 ± 0.5 mm, the width of the test sample was 15 ± 0.25 mm, a tensile speed was set to be 50 mm/min, and the chuck distance of the testing machine was 125 ± 0.1 mm. Five parallel samples were tested, and an average value was taken as a test result. During the test, the length direction of the test sample was parallel to the axial line of a clamp, the sample was maintained at a linear state, and an experiment temperature was $20\pm5^{\circ}\text{C}$.

Elongation rate test: A tensile testing machine was used for testing. The length of a test sample was 200 ± 0.5 mm, the width of the test sample was 15 ± 0.25 mm, a tensile speed was set to be 50 mm/min, the chuck distance of the testing machine was 125 ± 0.1 mm. Five parallel samples were tested, and an average value thereof was taken as a test result. During the test, the length direction of the test sample was parallel to the axial line of a clamp, the sample was maintained at a linear state, and the experiment temperature was $20\pm5^{\circ}\text{C}$. Elongation rate=tensile length/original length.

3. Performance test of lithium-ion battery

(1) Cycle performance test

A lithium-ion battery was charged to 4.45 V at a 1 C constant current under the condition of 45°C , stood for 30 minutes, and then discharged at 1 C to 3.0 V. The lithium-ion battery was cyclically charged and discharged for 500 times.

Capacity retention rate (%) of lithium-ion battery = discharge capacity after 500 cycles /initial discharge capacity $\times 100\%$.

(2) 60°C high-temperature storage test

The lithium-ion battery was put into a 25°C incubator, and was charged to 3.95 V at a 0.5 C constant current; and the thickness of the battery was tested. Then, the battery was fully charged to 4.45 V. The battery was put into a 60°C oven and stored for 30 days. During this period, the thickness of the battery was tested every 3 days. If the thickness increase rate of the battery relative to that under the condition of 3.95 V is greater than 60%, the test was stopped.

Thickness increase rate = (thickness after storage-thickness under the condition of 3.95 V) / thickness under the condition of 3.95 V $\times 100\%$.

(3) Floating charging leakage current test

The lithium-ion battery was stood for 120 minutes under the condition of 45°C, was charged to 4.45 V at 1 C, and was maintained at a constant-voltage charge state for 15 days. The magnitude of the current after the 15 days was recorded.

(4) Battery extrusion test

The lithium-ion battery was put into a 25°C incubator, charged to 4.45 V at a 0.5 C constant current, and was then charged at a constant voltage to reach a 0.05 C current. Then, the battery was extruded by a 20 KN pressure, and whether combustion or explosion occurred to the battery was observed.

A. The electrolytes and the lithium-ion batteries in Examples 1-39 and Comparative Examples 1-6 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.5\%$, a thickness of 6 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 3\%$. B% (*i.e.*, the proportion of the area of a second region in the surface area of the negative electrode) was 18.2%, and the tab was connected to the second region by welding. The width W of the tab was 0.8 cm. The distance C between the tab and the edge of the current collector was 2 cm. The width D of an edge folded region of the second region located at the edge of the current collector was 1.8 cm. Tab of the positive electrode was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. Test results are shown in Table 1.

Table 1

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	Proportion of area of second region in surface area of current collector B (%)	Ax B	Capacity retention rate (%)	Floating charging leakage current (mA)	60°C high-temperature storage test (%)
Example 1	Compound 1	0.3	18.2	5.46	70	4	48
Example 2	Compound 1	1	18.2	18.2	78	5	35
Example 3	Compound 1	3	18.2	54.6	75	7	15

Example 4	Compound 1	5	18.2	91	74	9	14
Example 5	Compound 1	10	18.2	182	67	20	14
Example 6	Compound 2	1	18.2	18.2	87	6	33
Example 7	Compound 2	3	18.2	54.6	86	8	15
Example 8	Compound 2	10	18.2	182	72	18	14
Example 9	Compound 3	0.3	18.2	5.46	72	4	47
Example 10	Compound 3	1	18.2	18.2	84	7	36
Example 11	Compound 3	3	18.2	54.6	79	9	18
Example 12	Compound 3	10	18.2	182	72	23	18
Example 13	Compound 5	0.3	18.2	5.46	70	3	50
Example 14	Compound 5	1	18.2	18.2	82	5	32
Example 15	Compound 5	3	18.2	54.6	81	6	13
Example 16	Compound 5	5	18.2	91	75	9	10
Example 17	Compound 5	10	18.2	182	70	19	10
Example 18	Compound 6	1	18.2	18.2	81	3	23
Example 19	Compound 6	3	18.2	54.6	81	4	14
Example 20	Compound 6	10	18.2	182	70	23	14
Example 21	Compound 7	0.3	18.2	5.46	70	3	51
Example 22	Compound 7	1	18.2	18.2	85	5	35
Example 23	Compound 7	3	18.2	54.6	83	6	13
Example 24	Compound 7	10	18.2	182	70	19	13
Example 25	Compound 1+ Compound 2	1.5+1.5	18.2	54.6	81	5	37
Example 26	Compound 1+ Compound 3	1.5+1.5	18.2	54.6	83	4	35
Example 27	Compound 1+ Compound 4	1.5+1.5	18.2	54.6	81	5	34
Example	Compound 1+	1.5+1.5	18.2	54.6	83	3	35

28	Compound 5						
Example 29	Compound 1+ Compound 6	1.5+1.5	18.2	54.6	87	3	33
Example 30	Compound 1+ Compound 7	1.5+1.5	18.2	54.6	85	3	37
Example 31	Compound 2+ Compound 5	1.5+1.5	18.2	54.6	83	5	34
Example 32	Compound 2+ Compound 6	1.5+1.5	18.2	54.6	83	8	35
Example 33	Compound 2+ Compound 7	1.5+1.5	18.2	54.6	81	4	30
Example 34	Compound 3+ Compound 6	1.5+1.5	18.2	54.6	80	5	37
Example 35	Compound 3+ Compound 7	1.5+1.5	18.2	54.6	85	4	35
Example 36	Compound 1+ Compound 2+ Compound 3	1+1+1	18.2	54.6	81	3	35
Example 37	Compound 2+ Compound 4+ Compound 5	1+1+1	18.2	54.6	84	2.9	35
Example 38	Compound 3+ Compound 4+ Compound 6	1+1+1	18.2	54.6	84	4	36
Example 39	Compound 5+ Compound 6+ Compound 7	1+1+1	18.2	54.6	87	4	36
Comparative example 1	/	0	18.2	0	61	2.5	Test stopped due to serious gas expansion
Comparative example 2	Compound 2	12	18.2	218.2	56	45	20
Comparative example 3	Compound 3	12	18.2	218.2	54	38	23
Comparative example 4	Compound 5	12	18.2	218.2	56	43	21
Comparative example 5	Compound 6	12	18.2	218.2	59	36	18
Comparative example 6	Compound 7	15	18.2	345	51	51	19

Note: "/" represents absent.

Table 1 shows examples and comparative examples wherein B% (the proportion of the area of the second region in the surface area of the negative electrode) was fixed to be 18.2%. Compared with Comparative Example 1 wherein no nitrile compound was added to the electrolyte, Examples 1 to 39, in which a specific nitrile compound ranging from 0.1 wt% to 10 wt% was added into the electrolyte, show significantly improved cycle performance. From Comparative Examples 2 to 5 and Comparative Example 1, it can be seen that when increasing the content of the nitrile compound to 12 wt% so that the value of A times B reaches 218.2, the cycle performance was improved compared with that of Comparative Example 1, but the degree of improvement was reduced; and meanwhile, battery self-discharging was further improved. From Comparative Example 6, it can be seen that when increasing the content of the nitrile compound to 15% so as to make the product of A and B be greater than 210, the floating charging leakage current exceeded 50 mA, which seriously affected the function of the battery. Therefore, for conditions where the electrolyte contains 0.1 wt% to 10 wt% of the specific nitrile compound, when the tab and the second region is connected by welding, making the value of A times B be less than 210 can improve battery performance and meanwhile introduce small self-discharging. Addition of the nitrile compound can improve cycle performance because nitrile groups can complex with metal ions on the positive electrode and stabilize potential of the metal ions, thereby reducing phase changing of the structure of the positive electrode material. Meanwhile, the nitrile compound can adhere on the surface of the positive electrode to decrease contact between the positive electrode and the electrolyte. Due to a combination of the two effects, the cycle and floating charging performances of the battery can be significantly improved. However, the nitrile compound may cause a certain degree of dissolution of the copper foil current collector of the negative electrode. Particularly when a copper foil current collector with no active substance on its surface is exposed in the electrolyte, the dissolution of the copper foil caused by the nitrile compound is greatly enhanced. Dissolved copper ions can be slowly reduced into elemental copper and continuously deposited on the surface of the negative electrode during the charging and discharging process of the battery, which finally would cause a local short circuit and deteriorate the self-discharging of the battery. Although the nitrile compound may deteriorate self-discharging of a battery, it can improve electric performance of the battery. Therefore, it is necessary to add a certain content of nitrile compound into the electrolyte, and control the area of the exposed bare copper foil within a certain range, in order to control both the electric performance and self-discharging of the battery.

B. The electrolytes and the lithium-ion batteries in Examples 40 to 52 and Comparative Example 8 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil

had a purity of $\geq 99.8\%$, a thickness of 8 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 3\%$. The tab and the second region were connected by welding. The width W of the tab was 0.8 cm; the distance C between the tab and the edge of the current collectors was 2 cm; the width D of the edge folded region of the second region located at the edge of the current collector was 2.5 cm. The tab of the positive electrode was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 2.

Table 2

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	Proportion of area of second region in surface area of current collector B (%)	Ax B	Capacity retention rate (%)	Floating charging leakage current (mA)	60°C high-temperature storage test (%)
Example 40	Compound 2	3	9.1	27.3	83	8	32
Example 41	Compound 3	3	17.6	52.8	88	8	32
Example 42	Compound 4	3	21.9	65.7	88	15	30
Example 43	Compound 5	3	23	69	86	16	35
Example 44	Compound 6	3	27	81	85	17	34
Example 45	Compound 7	3	31	93	81	11	34
Example 46	Compound 2+ Compound 3	1.5+1.5	17.6	52.8	81	6	37
Example 47	Compound 3+ Compound 4	1.5+1.5	17.6	52.8	81	3	34
Example 48	Compound 3+ Compound 5	1.5+1.5	21.9	65.7	81	6	36
Example 49	Compound 3+ Compound 5+ Compound 7	1+1+1	23	69	81	21	36
Example	Compound	1+1+1	23	69	81	23	35

50	2+ Compound 4+ Compound 5						
Example 51	Compound 2+ Compound 4+ Compound 6	1+1+1	23	69	81	23	35
Example 52	Compound 2	3	0.4	1.2	82	0.6	35
Comparative example 8	Compound 2	3	85	255	70	47	37

Table 2 shows examples and comparative examples with the content of the nitrile compound in the electrolyte being 3 wt%. As shown in Examples 40 to 51, when the content of the nitrile compound in the electrolyte was fixed to 3 wt%, the cycle and storage performances of the batteries were good. With adjustment of the area of the second region of the negative electrode in the battery to increase the value of A times B, the floating charging leakage current of the batteries was increased. As shown in Comparative Example 8, when the value of A times B exceeds 210, serious self-discharging occurred, which affected the function of the batteries. The current collector of the negative electrode in Example 52 did not include a second region (i.e., B is 0.4), so that the value of A times B is 1.2. Compared with Comparative Example 8, the battery of Example 52 achieved better cycle performance and smaller leakage current.

C. The electrolytes and the lithium-ion batteries in Examples 53 to 60 and Comparative Example 9 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 2\%$. The tab and the second region were connected through cutting; the number of the tabs was 9, the width W of the tab was 1.5 cm; the width D of the edge folded region of the second region positioned at the edge of the current collector was 1.5 cm. The tab of the positive electrode was correspondingly prepared by cutting. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 3.

Table 3

	Nitrile compound	Mass percentage of nitrile	Proportion of area of second	AxB	Capacity retention	Floating charge	60°C high-temperature
--	------------------	----------------------------	------------------------------	-----	--------------------	-----------------	-----------------------

		compound in electrolyte A (%)	region in surface area of current collector B (%)		n rate (%)	ng leakag e curren t (mA)	ure storage test (%)
Example 53	Compound 1	3	18.1	54.3	83	2	34
Example 54	Compound 2	3	22.5	67.5	85	3	28
Example 55	Compound 4	3	36.7	110.1	86	6	29
Example 56	Compound 5	3	54	162	83	21	32
Example 57	Compound 1+ Compound 2	1.5+1.5	18.1	54.3	84	4	33
Example 58	Compound 2+ Compound 4	1.5+1.5	18.1	54.3	81	3	33
Example 59	Compound 2+ Compound 4+ Compound 5	1.5+1.5+1.5	18.1	54.3	83	4	26
Example 60	Compound 2	3	2.3	6.9	83	0.2	31
Comparative example 9	Compound 5	12	54	648	80	40	15

As shown in Table 3, in Examples 53 to 60 and Comparative Example 9, the tabs of the batteries were all prepared by cutting. Examples 53 to 59 show that adjustment of B% (*i.e.*, the proportion of the area of the second region) did not seem to significantly affect the capacity retention rate of the battery, but increased self-discharging of the battery. In Comparative Example 9 where A% (the mass percentage of the nitrile compound) was 12 wt% and B% (the proportion of the area of the second region) was 54% so that the value of A times B was 648, the self-discharging current reached 40 mA. The current collector of the negative electrode in Example 60 was completely coated with an active material, but no active material was applied to the tabs (*i.e.*, B%=2.3%, which is the proportion of a bare copper foil at the positions of the tabs), so that the value of A times B is 6.9. Compared with Comparative Example 9, the battery of Example 60 achieved better cycle and storage performances and smaller leakage current. In view of the

above, when preparing the tabs of the batteries by cutting, the value of A times B should be controlled within 600 to arrive at good battery performance.

D. The electrolytes and the lithium-ion batteries in Examples 61 to 63 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of $\geq 30 \text{ kg/mm}^2$, and an elongation rate of $\geq 2\%$. The tab and the second region were connected by welding. The width of the tab was 0.8 cm. The distance C between the tab and the edge of the current collector was 2 cm. The width D of the edge folded region of the second region positioned at the edge of the current collector was 1.8 cm. The tabs of the positive electrode were correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 4.

Table 4

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	AxB	Capacity retention rate (%)	Floating charging leakage current (mA)	60°C high-temperature storage test (%)
Example 61	Compound 1	3	42	85	4	35
Example 62	Compound 1	3	75	84	8	34
Example 63	Compound 1	3	76.8	85	12	34

As shown in Table 4, in Example 61, the copper foil region not coated with the active substance layer was covered by a certain area of a polymer adhesive tape so as to reduce the contact area between the copper foil and the electrolyte. Compared with Example 63 which did not use the polymer adhesive tape, Example 61 achieved lower leakage current. In Example 62, the welding position of the tab was covered with a certain area of a polymer adhesive tape. Compared with Example 63 which did not use the polymer adhesive tape, the self-discharging of the battery of Example 62 was decreased. Therefore, in practical battery design, the welding position of the tab on the copper foil current collector of the negative electrode and other bare copper foil regions not coated with negative electrode active substances can be covered with a polymer adhesive tape or another substance capable of being bond onto the copper foil and tab, in order to reduce self-discharging of the battery.

E. The electrolytes and the lithium-ion batteries in Examples 64 to 70 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 2\%$. The tab and the second region were connected by welding; the width of the tab was 0.8 cm; the distance C between the tab and the edge of the current collector was 2 cm; and the width D of the edge folded region of the second region positioned at the edge of the current collectors was 1.8 cm. The tab of the positive electrode was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 5.

Table 5

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	Other additives and mass percentage thereof in electrolyte (%)	A* B	Capacity retention rate (%)	Floating charging leakage current (mA)	60°C high-temperature storage test (%)
Example 64	Compound 1	3	PS 1	52.5	87%	5	25
Example 65	Compound 2	3	FEC+PS 1+1	52.5	84%	3	23
Example 66	Compound 4	3	PS+VC 1+0.5	52.5	86%	2.4	17
Example 67	Compound 5	3	DTD+SA 1+0.5	52.5	86%	8	16
Example 68	Compound 2	3	MMDS+V C 0.5+0.5	52.5	85%	7	17
Example 69	Compound 4	3	PS+VC+D TD 1+0.5+1	52.5	88%	10	15
Example 70	Compound 1	3	/	52.5	75%	11	36

Note: "/" represents not added.

From Examples 64 to 69 and Example 70, it can be seen that addition of other additives in the electrolyte containing specific nitride compounds can significantly improve the cycle performance and floating charging thickness increase rate of batteries. The addition of FEC can increase the LiF content of the negative electrode SEI, and can improve stability of the negative electrode SEI. The addition of VC can facilitate the formation of a reticular protection layer at

the surface layer of SEI through polymerization, and can increase flexibility of SEI. Addition of other additives can stabilize or strengthen the SEI protection layer to a certain degree. Therefore, the cycle performance of battery was improved. Meanwhile, due to a film forming effect of the additives on the negative electrode, deposition of copper ions on the negative electrode can be reduced to a certain degree, self-discharging of the battery can be reduced, which further improved the overall electric performance of the battery.

Therefore, it can be seen from the examples and the comparative examples that the nitrile compound as an effective additive for improving the cycle stability has great influence on the self-discharging of the battery. In order to improve the long-term storage performance of the battery, it is necessary to control the content of the nitrile compound and the area of the bare copper foil region within a certain range so as to ensure that the capacity of the battery would not be significantly reduced after long-term storage. Meanwhile, through addition of a certain content of other additives into the electrolyte, the cycle performance and self-discharging of the battery can be improved, and the long-term cycle and storage of the battery can be ensured.

F. The electrolytes and the lithium-ion batteries in Examples 71 to 72 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 2\%$. The tab and the second region were connected by welding. The width W of the tabs was 0.8 cm. The distance C between the tab and the edge of the current collectors was 2 cm. In Example 71, the width D of the edge folded region of the second region positioned at the edge of the current collector was 1.8 cm. In Example 72, the edge of the second region positioned at the edge of the current collector was not folded. The positive electrode tab was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 6.

Table 6

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	AxB	Capacity retention rate (%)	Floating charging leakage current (mA)	Extrusion test
Example 71	Compound 2	3	52.5	84%	5	No combustion occurred

Example 72	Compound 2	3	52.5	83%	6	Combustion occurred
-------------------	------------	---	------	-----	---	---------------------

As shown in Table 6, in Example 71, the edge of the second region positioned at the edge of the current collector was folded; and in Example 72 the edge of the second region positioned at the edge of the current collector was not folded. The capacity retention rates and the floating charging leakage current of Example 71 and Example 72 did not show obvious differences, but the extrusion test showed that the risk of piercing the separator by burrs in the welding position of the tab was reduced due to the folding, which made the battery achieve better safety performance.

G. The electrolytes and the lithium-ion batteries in Examples 73 to 76 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of $\geq 30 \text{ kg/mm}^2$, and an elongation rate of $\geq 2\%$. The tab and the second region were connected by welding. The width W of the tab was 0.8 cm. The distance C between the tab and the edge of the current collector was 2 cm. The width D of the edge folded region of the second region positioned at the edge of the current collector was 1.8 cm. The tab of the positive electrode was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 7.

Table 7

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	AxB	Cl ⁻ content (ppm)	Capacity retention rate (%)	Floating charging leakage current (mA)
Example 73	Compound 5	3	36.9 %	100	81%	7
Example 74	Compound 5	3	36.9 %	500	82%	6
Example 75	Compound 5	3	36.9 %	1000	80%	5
Example 76	Compound 5	3	36.9 %	1100	75%	4

As shown in Table 7, addition of a proper amount of an anion (e.g., Cl^-) in the electrolyte can improve leakage current of the battery. However, high amount of the anion (e.g., exceeding

1000 ppm) would greatly affect the capacity retention rate of the battery. Therefore, while ensuring the electric performance of the battery, a proper amount of the anion may be added into the electrolyte to improve the floating charging leakage current.

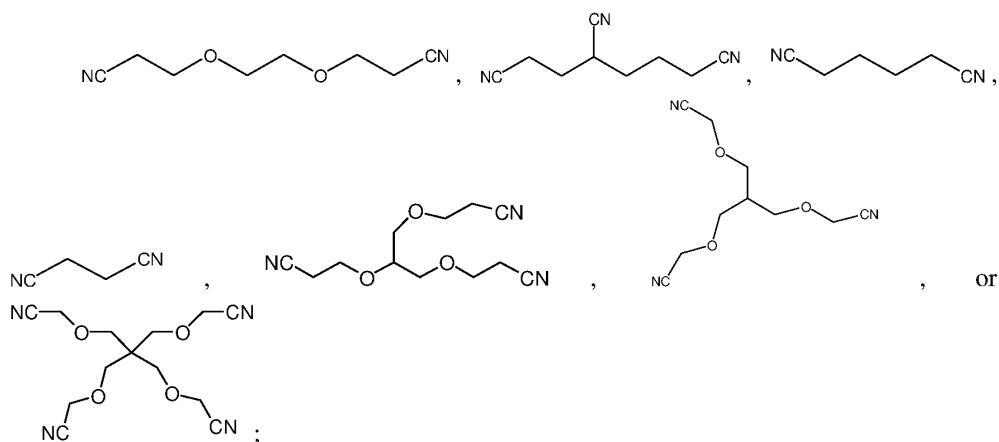
The foregoing descriptions are merely a few embodiments of the present application and are not intended to limit the present application in any manner. Although the present application is described with reference to preferred embodiments, the embodiments are not intended to limit the present application.

Throughout the specification, references to "embodiment," "part of embodiments," "one embodiment," "another example," "example," "specific example" or "part of examples" mean that at least one example or example of the present application includes specific features, structures, materials or characteristics described in the embodiment or example. Thus, the descriptions appear throughout the specification, such as "in some embodiments," "in an embodiment," "in one embodiment," "in another example," "in an example," "in a particular example" or "for example," are not necessarily the same embodiment or example in the application. Furthermore, the specific features, structures, materials or characteristics in the descriptions can be combined in any suitable manner in one or more embodiments or examples.

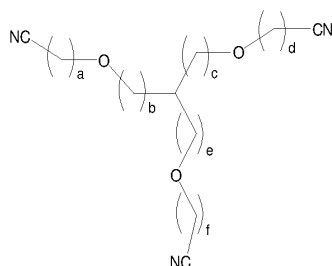
Although the illustrative embodiments have been shown and described, it should be understood by those skilled in the art that the above embodiments cannot be interpreted as limitations to the present application, and the embodiments can be changed, substituted and modified without departing from the spirit, principle and scope of the present application.

What is claimed is:

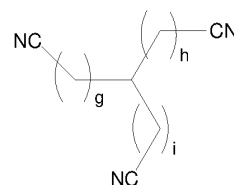
- the nitrile compound comprises at least one of:


$$A \times B < 600.$$

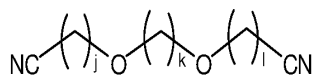
2. The electrochemical device according to claim 1, wherein the nitrile compound comprises at least one of a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V or a compound of Formula VI:



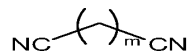
Formula I,



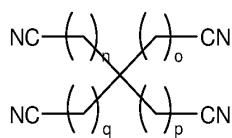
Formula II,



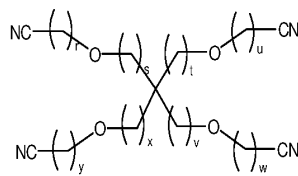
Formula III,



Formula IV,



Formula V, and



Formula VI,

wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is an integer independently selected from 0 to 5; and the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%.

3. The electrochemical device according to claim 1, wherein the negative electrode comprises at least one tab, the tab is formed by being connected to the second region through welding, and $A \times B < 210$.

4. The electrochemical device according to claim 1, wherein the negative electrode comprises at least one tab, the tab is formed by cutting the current collector, the tab comprises a region not coated with the negative electrode active substance layer, and $A \times B < 500$.

5. The electrochemical device according to claim 3, wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to an edge of the current collector and the edge of the current collector is C, and $0 \leq C/\text{tab width} \leq 50$.

6. The electrochemical device according to claim 4, wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to the edge of the current collector and the edge of the current collector is C, and $0 \leq C/\text{tab width} \leq 50$.

7. The electrochemical device according to claim 1, wherein at least one of the second region is positioned at the edge of the current collector, and an edge of the second region positioned at the edge of the current collector is either folded or not folded, wherein when the edge of the second region positioned at the edge of the current collector is folded, a width of the folded region is D , and $0.1 \leq D/\text{tab width} \leq 20$.

8. The electrochemical device according to claim 1, wherein the current collector is a copper foil and the copper foil has one or more of the following properties:

- a copper purity of $\geq 99.5\%$,
- a thickness of 3 microns to 15 microns,
- a weight per unit area of 30 g/m^2 to 150 g/m^2 ,
- a tensile strength of $\geq 20 \text{ kg/mm}^2$, and
- an elongation rate of $\geq 1.5\%$.

9. The electrochemical device according to claim 1, wherein the second region is covered by a substance adhered onto the second region.

10. The electrochemical device according to claim 3, wherein a position of the at least one tab is covered by a substance bond onto the position of the tab.

11. The electrochemical device according to claim 4, wherein a position of the at least one tab is covered by a substance bond onto the position of the tab.

12. The electrochemical device according to claim 1, wherein the electrolyte further comprises an additive, and the additive comprises at least one of the following: 1,3-propane sultone, fluoroethylene carbonate, vinylene carbonate, 2,4-butane sultone, 1,4-butane sultone, methylene methanedisulfonate, ethylene sulfate, succinic anhydride, ethoxy(pentafluoro)cyclotriphosphazene, 1,3-dioxane, or propenyl-1,3-sultone.

13. The electrochemical device according to claim 1, wherein the electrolyte further comprises an anion, the anion comprises at least one of Cl^- , Br^- , SO_4^{2-} , CO_3^{2-} or F^- , and the content of the anion in the electrolyte is less than or equal to 1000 ppm.

14. An electronic device, comprising an electrochemical device, wherein the electrochemical device comprises a positive electrode, a negative electrode, a separator

and an electrolyte; wherein

the electrolyte comprises a nitrile compound, and a mass percentage of the nitrile compound in the electrolyte is A%;

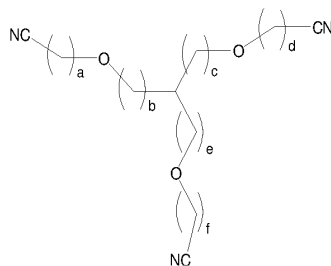
the negative electrode comprises a current collector, wherein the current collector comprises a first region and a second region;

a negative electrode active substance layer is provided only in the first region;

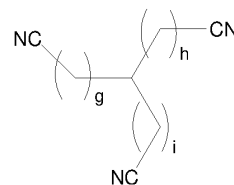
an area of the second region is B% of the surface area of the current collector; and

$A \times B < 600$.

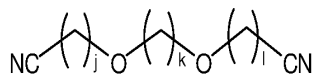
15. The electronic device according to claim 14, wherein the nitrile compound comprises at least one of a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V or a compound of Formula VI:



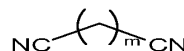
Formula I,



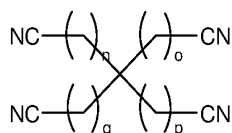
Formula II,



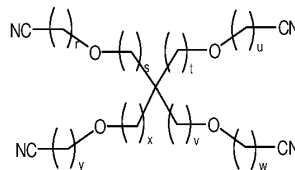
Formula III,



Formula IV,



Formula V, and



Formula VI,

wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is an integer independently selected from 0 to 5; and the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%.

16. The electrochemical device according to claim 14, wherein the nitrile compound comprises at least one of:

19. The electrochemical device according to claim 14, wherein the second region is covered by a substance adhered onto the second region.

ABSTRACT

An electrochemical device, including a positive electrode, a negative electrode, a separator and an electrolyte. The electrolyte includes a nitrile compound, and the mass percentage of the nitrile compound in the electrolyte is A%; the negative electrode includes a current collector, wherein the current collector comprises a first region and a second region; the first region is provided with a negative electrode active substance layer; the second region does not comprise a negative electrode active substance layer; the area of the second region is B% of the surface area of the current collector; and $A \times B < 600$

ELECTROLYTE AND ELECTROCHEMICAL DEVICE**CROSS REFERENCE TO RELATED APPLICATIONS**

The present application is a continuation application of US Application 16/970864, which is a National Stage application of International Application No. PCT/CN2020/077638, filed on Mar. 3, 2020, the contents of which are incorporated herein by reference in its entirety.

TECHNICAL FIELD

The present application relates to the technical field of energy storage, and more particularly to an electrolyte and an electrochemical device including the electrolyte.

BACKGROUND

Electrochemical devices, such as lithium-ion batteries, have the advantages of high energy density, high working voltage, low self-discharging rate, long cycle life, no pollution and the like, and thus have been widely applied to the fields of computers, intelligent wearable devices, smart phones, unmanned aerial vehicles, electric vehicles and the like. With the development of modern information technology and the expansion of the application range of lithium-ion batteries, there are higher requirements on energy density of lithium-ion batteries in the art.

There are many factors affecting the energy density of lithium-ion batteries. At present, improving a charging cut-off voltage of the lithium-ion battery is one of the effective measures for improving the energy density, but the voltage improvement causes deterioration of positive electrode stability. How to solve the above-mentioned problem to increase the energy density of lithium-ion batteries has become an urgent problem to be solved in the art.

SUMMARY

Through research, the inventor discovers that although nitrile additives may effectively improve stability of positive electrode and thus significantly improve properties such as cycle performance of electrochemical devices, the nitrile additives may cause copper dissolution from current collector of negative electrode, thus influencing stability of negative electrode, and particularly, battery self-discharging or even safety problems may occur when copper ions are dissolved at welding position of tab.

The present application provides an electrochemical device capable of meeting high-voltage

cycle stability, solving the self-discharging problem of electrochemical devices at high voltage, and improving safety characteristics.

In some embodiments, the present application provides an electrochemical device, including a positive electrode, a negative electrode, a separator and an electrolyte, wherein the electrolyte includes a nitrile compound, and the mass percentage of the nitrile compound in the electrolyte is A%.

The negative electrode includes a current collector, and the current collector includes a first region and a second region;

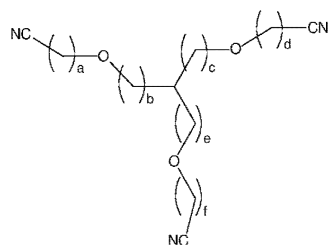
the first region is provided with a negative electrode active substance layer;

the second region does not include a negative electrode active substance layer;

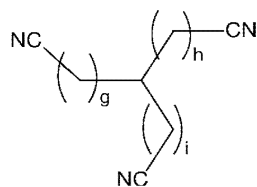
the area of the second region accounts for B% of the surface area of the current collector; and

$A \times B < 600$.

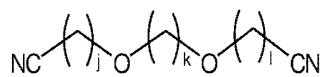
In some embodiments, the nitrile compound includes at least one of the following: a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V or a compound of Formula VI:



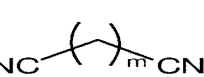
Formula I,



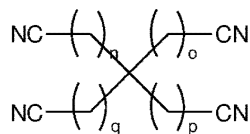
Formula II,



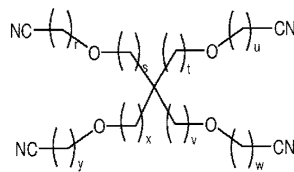
Formula III,



Formula IV,



Formula V, and

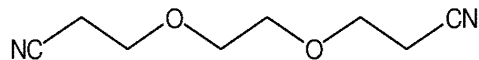


Formula VI,

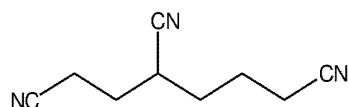
wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is an integer independently selected from

0 to 5; and the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%.

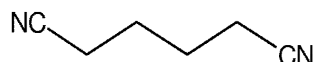
In some embodiments, the nitrile compound includes at least one of the following compounds:



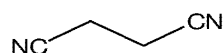
Compound 1,



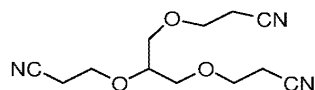
Compound 2,



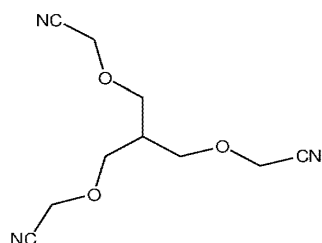
Compound 3,



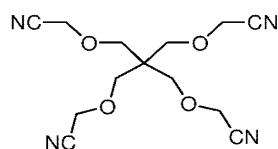
Compound 4,



Compound 5,



Compound 6, or



Compound 7.

In some embodiments, the negative electrode includes a tab. The tab is formed through being connected to the second region by welding, and $A \times B < 210$.

In some embodiments, the negative electrode includes at least one tab, and the tab is formed by cutting the current collector. The tab includes a region not coated with a negative electrode active substance layer, and $A \times B < 500$.

In some embodiments, at least one of the second region is positioned at an edge of the current collector, a distance between the tab closest to the edge of the current collector and the edge of the current collector is C, and $0 \leq C/\text{tab width} \leq 50$.

In some embodiments, at least one of the second region is positioned at the edge of the current collector, and an edge of the second region positioned at the edge of the current collector is either folded or not folded, wherein if the edge of the second region positioned at the edge of the current collector is folded, the width of the folded region is D, and $0.1 \leq D/\text{tab width} \leq 20$.

In some embodiments, the current collector is a copper foil, and the copper foil has one or more of the following properties:

- a copper purity of $\geq 99.5\%$,
- a thickness of 3 microns to 15 microns,
- a weight per unit area of 30 g/m² to 150 g/m²,
- a tensile strength of ≥ 20 kg/mm², and
- an elongation rate of $\geq 1.5\%$.

In some embodiments, the second region is optionally covered by a substance capable of being adhered onto the second region.

In some embodiments, a portion of the tab is optionally covered by a substance capable of being adhered onto the portion of the tab.

In some embodiments, the electrolyte further includes an additive. The additive includes at least one of the following: 1,3-propane sultone, fluoroethylene carbonate, vinylene carbonate, 2,4-butane sultone, 1,4-butane sultone, methylene methanedisulfonate, ethylene sulfate, succinic anhydride, ethoxy(pentafluoro)cyclotriphosphazene, 1,3-dioxane, or propenyl-1,3-sultone.

In some embodiments, the electrolyte further includes an anion, and the anion includes at least one of the following: Cl⁻, Br⁻, SO₄²⁻, CO₃²⁻ or F⁻, and the content of the anion in the electrolyte is less than or equal to 1000 ppm.

In another aspect, the present application provides an electronic device, and the electronic device includes any of the electrochemical devices above.

Additional aspects and advantages of the embodiments of the present application will be described or shown in the following description or interpreted by implementing the embodiments of the present application.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of a current collector of a negative electrode according to an embodiment of the present application.

FIG. 2 is a side view of the current collector in FIG. 1 in direction Z.

FIG. 3 is a top view of a current collector of a negative electrode according to another embodiment of the present application.

FIG. 4 is a side view of the current collector in FIG. 3 in direction Z.

FIG. 5 is a side view of a current collector of a negative electrode according to another embodiment of the present application.

FIG. 6 is a side view of a current collector of a negative electrode according to another embodiment of the present application.

FIG. 7 is a side view of a current collector of a negative electrode according to another embodiment of the present application.

FIG. 8 is a top view of a current collector of a negative electrode according to another embodiment of the present application.

DETAILED DESCRIPTION

The embodiments of the present application will be described in detail below. The embodiments of the present application should not be interpreted as limitations to the protection scope of the present application. Unless otherwise expressly indicated, the following terms used herein have the meanings indicated below.

As used in the present application, terms "approximately", "substantially", "essentially", and "about" are used for describing and explaining a small variation. When being used in combination with an event or circumstance, the term may refer to an example in which the event or circumstance occurs precisely, and an example in which the event or circumstance occurs approximately. For example, when being used in combination with a value, the term may refer to a variation range of less than or equal to $\pm 10\%$ of the value, for example, less than or equal to $\pm 5\%$, less than or equal to $\pm 4\%$, less than or equal to $\pm 3\%$, less than or equal to $\pm 2\%$, less than or equal to $\pm 1\%$, less than or equal to $\pm 0.5\%$, less than or equal to $\pm 0.1\%$, or less than or equal to $\pm 0.05\%$, and then it may be regarded that two values are "substantially" the same.

In addition, sometimes, a quantity, a ratio, and another value are presented in a range format in

the present application. It should be appreciated that such range formats are for convenience and conciseness, and should be flexibly understood as including not only values explicitly specified to range constraints, but also all individual values or sub-ranges within the ranges, like explicitly specifying each value and each sub-range.

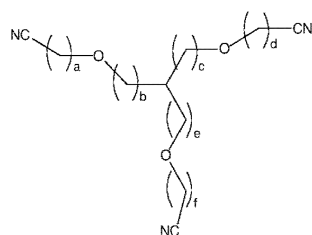
In the detailed description and the claims, a list of items connected by the term "at least one of" may mean any one of the listed items. For example, if items A and B are listed, then the phrase "one of A and B" means only A or only B. In another example, if items A, B, and C are listed, then the phrase "one of A, B and C" means only A; only B; or only C. The item A may include a single component or multiple components. The item B may include a single component or multiple components. The item C may include a single component or multiple components.

In the detailed description and the claims, a list of items connected by the term "at least one of" may mean any combination of the listed items. For example, if items A and B are listed, then the phrase "at least one of A and B" or "at least one of A or B" means only A; only B; or A and B. In another example, if items A, B and C are listed, then the phrases "at least one of A, B and C" or "at least one of A, B or C" mean only A; or only B; only C; A and B (excluding C); A and C (excluding B); B and C (excluding A); or all of A, B and C. The item A may include a single component or multiple components. The item B may include a single component or multiple components. The item C may include a single component or multiple components.

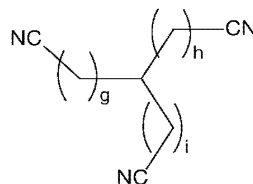
As used herein, the content of each ingredient in an electrolyte is obtained on the basis of the total weight of the electrolyte.

1. Electrolyte

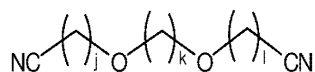
In some embodiments, the electrolyte of the present application includes a nitrile compound, and the nitrile compound includes at least one of a compound shown as Formula I, a compound shown as Formula II, a compound shown as Formula III, a compound shown as Formula IV, a compound shown as Formula V or a compound shown as Formula VI:



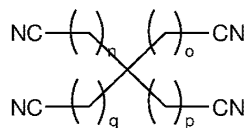
Formula I,



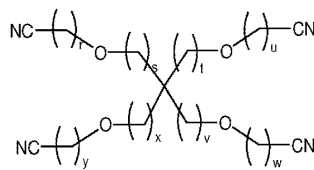
Formula II,

Formula III, $\text{NC}-(\text{CH}_2)_m-\text{CN}$

Formula IV,



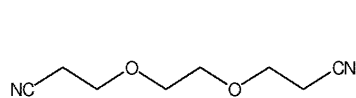
Formula V, and



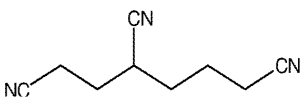
Formula VI,

wherein each of a, d, f, j, k, l, m, r, u, w and y is independently selected from 1, 2, 3, 4 or 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is independently selected from 0, 1, 2, 3, 4 or 5; the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%, 0.3% to 8%, 1% to 6%, or 3% to 4%; and in some embodiments, A% is about 0.5%, about 1.5%, about 2.5%, about 3.5%, about 4.5%, about 5.5%, about 6.5%, about 7.5%, about 8.5% or about 9.5%.

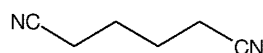
In some embodiments, the nitrile compound includes at least one of the following compounds:



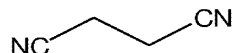
Compound 1,



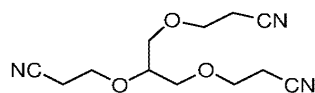
Compound 2,



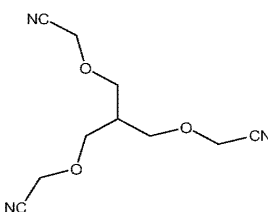
Compound 3,



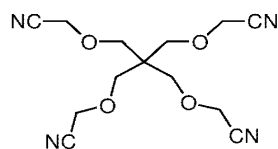
Compound 4,



Compound 5,



Compound 6, or



Compound 7.

In some embodiments, in order to further improve performance of a lithium-ion battery, the electrolyte further includes one or more of the following additives: 1,3-propane sultone (PS), fluoroethylene carbonate (FEC), vinylene carbonate (VC), 2,4-butane sultone, 1,4-butane sultone, methylene methanedisulfonate (MMDS), ethylene sulfate (DTD), succinic anhydride (SA), ethoxy(pentafluoro)cyclotriphosphazene and 1,3-dioxane (DOX), or propenyl-1,3-

sultone.

In some embodiments, in order to inhibit copper dissolution caused by the electrolyte containing the nitrile compound, the electrolyte may further contain an anion, such as at least one of the inorganic anions Cl^- , Br^- , SO_4^{2-} , CO_3^{2-} or F^- . In some embodiments, the content of the anion in the electrolyte is less than or equal to 1000 ppm.

In some embodiments, the electrolyte further includes a lithium salt and an organic solvent.

In some embodiments, the lithium salt is one or more selected from inorganic lithium salts and organic lithium salts. In some embodiments, the lithium salt contains at least one of a fluorine element, a boron element or a phosphorus element. In some embodiments, the lithium salt is selected from one or more of the following lithium salts: at least one of lithium hexafluorophosphate (LiPF_6), bistrifluoromethanesulfonimide lithium salt (LiTFSI), lithium bis(fluorosulfonyl)imide (LiFSI), lithium bis(oxalate)borate (LiBOB), lithium difluoro(oxalato)borate (LiDFOB), lithium hexafluoroarsenate (LiAsF_6), lithium perchlorate (LiClO_4) and lithium trifluoromethanesulfonate (LiCF_3SO_3).

In some embodiments, the concentration of the lithium salt is 0.5 M to 1.5 M. In some embodiments, the concentration of the lithium salt is 0.8 M to 1.2 M.

The organic solvent includes a cyclic ester and a chain ester; the cyclic ester is at least one selected from ethylene carbonate (EC), propylene carbonate (PC), γ -butyrolactone (BL) and 2,3-butylene carbonate; and the chain ester is at least one selected from dimethyl carbonate (DMC), diethyl carbonate (DEC), ethyl methyl carbonate (EMC), propylene carbonate, methyl formate (MF), ethyl formate (EF), ethyl acetate (EA), ethyl propionate (EP), propyl propionate (PP), methyl propionate, propyl acetate, methyl butyrate and ethyl butyrate.

2. Electrochemical device

The electrochemical device of the present application includes any device in which an electrochemical reaction occurs, and specific examples of the electrochemical device includes all kinds of primary batteries, secondary batteries, fuel cells, solar cells, or capacitors. Particularly, the electrochemical device is a lithium secondary battery including a lithium metal secondary battery, a lithium-ion secondary battery, a lithium polymer secondary battery or a lithium-ion polymer secondary battery. In some embodiments, the electrochemical device of the present application is an electrochemical device including a positive electrode with a positive electrode active substance capable of absorbing and releasing metal ions and a negative electrode with a negative electrode active substance capable of absorbing and releasing metal

ions, and is characterized by including any of the above electrolytes of the present application.

Electrolyte

The electrolyte used in the electrochemical device of the present application is any of the above electrolytes of the present application.

Negative Electrode

In the electrochemical device according to the present application, the negative electrode includes a current collector and a negative electrode active material layer arranged on the current collector. The negative electrode active material layer includes a negative electrode active material. The specific type of the negative electrode active material is not particularly limited, and may be selected according to requirements.

The negative electrode may be prepared according to a preparation method known in the art. For example, the negative electrode may be obtained through the following method: mixing an active material, a conductive material and a binder in a solvent to prepare an active material composition, and applying the active material composition to the current collector.

The negative electrode active material includes a material for reversible intercalation/deintercalation of lithium ions. In some embodiments, the material for reversible intercalation/deintercalation of lithium ions includes a carbon material. In some embodiments, the carbon material may be any carbon-based negative electrode active material commonly used in lithium-ion rechargeable batteries. In some embodiments, the carbon material includes, but is not limited to, crystalline carbon, amorphous carbon, or a mixture thereof. The crystalline carbon may be amorphous, plate-shaped, platelet-shaped, spherical or fibrous natural graphite or artificial graphite. The amorphous carbon may be soft carbon, hard carbon, carbonized mesophase pitch, calcined coke, and the like.

In some embodiments, the negative electrode active material layer includes a negative electrode active material. In some embodiments, the negative electrode active material includes, but is not limited to, lithium metal, structured lithium metal, natural graphite, artificial graphite, mesocarbon microbead (MCMB), hard carbon, soft carbon, silicon, silicon-carbon composite, Li-Sn alloy, Li-Sn-O alloy, Sn, SnO, SnO₂, lithiated TiO₂-Li₄Ti₅O₁₂ of a spinel structure, Li-Al alloy or any combination thereof.

In some embodiments, the negative electrode active material layer may include a binder, and optionally includes a conductive material. The binder increases binding of negative electrode

active material particles to each other and binding of the negative electrode active material to the current collector. In some embodiments, the binder includes, but is not limited to, polyvinyl alcohol, carboxymethyl cellulose, hydroxypropyl cellulose, diacetyl cellulose, polyvinyl chloride, carboxylated polyvinyl chloride, polyvinyl fluoride, an ethylene-oxide-containing polymer, polyvinylpyrrolidone, polyurethane, polytetrafluoroethylene, poly(1,1-difluoroethylene), polyethylene, polypropylene, styrene butadiene rubber, acrylated styrene butadiene rubber, epoxy resin, nylon, etc.

In some embodiments, the conductive material includes, but is not limited to, a carbon-based material, a metal-based material, a conductive polymer or a mixture thereof. In some embodiments, the carbon-based material is selected from natural graphite, artificial graphite, carbon black, acetylene black, Ketjen black, carbon fiber or any combination thereof. In some embodiments, the metal-based material is selected from metal powder, metal fiber, copper, nickel, aluminum and silver. In some embodiments, the conductive polymer is a polyphenylene derivative.

The current collector of the negative electrode in the electrochemical device according to the present application may be selected from a copper foil, a nickel foil, a stainless steel foil, a titanium foil, nickel foam, copper foam, a polymer substrate coated with a conductive metal, and combinations thereof. In some embodiments, the current collector includes a copper foil.

In some embodiments, the copper foil is formed through electrolysis or calendaring. Its purity is greater than or equal to 99.5%, and the total content of trace elements such as nickel, zinc and chromium is less than or equal to 0.5 wt%.

In some embodiments, the copper foil has one or more of the following properties:

- a copper purity of $\geq 99.5\%$;
- a thickness of 3 microns to 15 microns, for example, the thickness is about 4 microns, about 5 microns, about 6 microns, about 7 microns, about 8 microns, about 9 microns, about 10 microns, about 11 microns, about 12 microns, about 13 microns, or about 14 microns;
- a weight per unit area of 30 g/m^2 to 150 g/m^2 , for example, the weight in the unit area is about 50 g/m^2 , about 70 g/m^2 , about 90 g/m^2 , about 110 g/m^2 , or about 130 g/m^2 ;
- a tensile strength of $\geq 20 \text{ kg/mm}^2$, for example, the tensile strength $\geq 30 \text{ kg/mm}^2$, $\geq 40 \text{ kg/mm}^2$, or $\geq 50 \text{ kg/mm}^2$; and
- an elongation rate of $\geq 1.5\%$, for example, the elongation rate $\geq 2\%$, $\geq 2.5\%$, $\geq 3\%$, $\geq 3.5\%$,

or $\geq 4\%$.

In some embodiments, the copper foil is formed through electrolysis, its purity is greater than or equal to 99.5%, its thickness is about 6 microns, the tensile strength is greater than or equal to 30 kg/mm², and the elongation rate is greater than or equal to 3%.

In some embodiments, the copper foil has anti-corrosive properties, for example, no obvious color change occurs after the copper foil is soaked in an electrolyte prepared from ethylene carbonate (EC), propylene carbonate (PC) and diethyl carbonate (DEC) in a mass ratio of 3:1:7, and a LiPF₆ content being 1 mol/L at 45°C for about 48 hours.

The electrochemical device in some embodiments includes a positive electrode, a negative electrode, a separator and an electrolyte, wherein the electrolyte includes a nitrile compound. The mass percentage of the nitrile compound in the electrolyte is A%. The negative electrode includes a current collector. The current collector includes a first region and a second region, wherein the first region is provided with a negative electrode active substance layer; the second region does not include a negative electrode active substance layer. The area of the second region accounts for B% of the surface area of the current collector, and the value of A times B is smaller than 600, for example, the value of A times B is smaller than 550, smaller than 500, smaller than 450, smaller than 400, smaller than 350, smaller than 300, smaller than 250, smaller than 200, smaller than 150, smaller than 100, smaller than 50, smaller than 30, smaller than 15, or smaller than 5.

In some embodiments, the negative electrode includes a tab. The tab is formed through being connected to the second region by welding, and the value of A times B is smaller than 210. For example, the value of A times B is smaller than 200, smaller than 150, smaller than 100, smaller than 50, smaller than 30, smaller than 15, or smaller than 10.

FIG. 1 and FIG. 2 show schematic diagrams of a current collector of a negative electrode according to an embodiment of the present application. The current collector includes a first region 1 and a second region 2, wherein the first region is provided with a negative electrode active substance layer (as shown by gray region in the figure); and the second region does not include a negative electrode active substance layer. The negative electrode is provided with a tab 3, and the tab is formed by being connected to the second region through welding.

As shown in FIG. 2, in some embodiments, at least one second region is positioned at an edge of the current collector, wherein a distance between the tab closest to the edge of the current collector and the edge of the current collector is C, the width of the tab is W, and the range of "C/W (i.e., the ratio of C to W) is 0 to 50, for example, 5 to 40, 10 to 30, 15 to 40, or 20 to 30.

In some embodiments, the negative electrode is provided with 1 to 150 tabs, for example, the number of the tabs is 3, 5, 7, 9, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110, 120, 130, or 140; the tabs are formed by cutting the current collector; the tabs include regions not coated with the negative electrode active substance layer; the value of A times B is smaller than about 500; and for example, the value of A times B is smaller than 450, smaller than 400, smaller than 350, smaller than 300, smaller than 250, smaller than 200, smaller than 150, smaller than 100, smaller than 50, smaller than 30, smaller than 15 or smaller than 10.

FIG. 3 and FIG. 4 show schematic diagrams of a current collector of a negative electrode of another embodiment of the present application. The current collector includes a first region 1 and a second region 2, wherein the first region is provided with a negative electrode active substance layer; the second region does not include a negative electrode active substance layer. The negative electrode is provided with a plurality of tabs 3. The tabs are formed by cutting the current collector, and the tab includes a region not coated with the negative electrode active substance layer.

As shown in FIG. 5, in some embodiments, at least one second region is positioned at the edge of the current collector, and an edge of the second region positioned at the edge of the current collector is either folded or not folded. When the edge of the second region positioned at the edge of the current collector is folded, the width of the folded region is D, the width of the tab is W, and the range of "D/W" (i.e., the ratio of D to W) is 0.1 to 20, for example, 2 to 18, 4 to 16, 6 to 14, 8 to 12, or 9 to 10.

As shown in FIG. 6, in some embodiments, at least one second region is positioned at the edge of the current collector; and the negative electrode further includes one or more second regions positioned in the middle of the current collector, wherein the one or more second regions do not include a negative electrode active substance layer.

In some embodiments, in order to reduce the surface area of the second region as much as possible, the second region is optionally covered by a substance capable of being bond onto the second region. For example, as shown in FIG. 7, a part of the second region is covered by, for example but not limited to, a polymer adhesive tape 4.

In some embodiments, a position of the tab is optionally covered by a substance capable of being adhered onto the position of the tab. For example, as shown in FIG. 8, in order to reduce copper ion dissolution in a welding position of the tab and the second region, the welding part of the tab may be covered by, for example but not limited to, a polymer adhesive tape.

In the negative electrode of the present application, the first region (i.e., the region provided

with the negative electrode active substance layer) may be positioned on an upper surface, on a lower surface, or on both the upper and lower surfaces of the current collector of the negative electrode; the second region may be positioned at the edge and/or the inside of the current collector of the negative electrode; and the second region further includes a tab-welding position, a tab region formed through cutting, and an edge folded region.

Positive Electrode

A material of the positive electrode used in the electrochemical device of the present application may be prepared by using materials, structures, and manufacturing methods known in the art. In some embodiments, techniques recorded in US9812739B may be used for preparing the positive electrode of the present application, which is incorporated into the present application by reference in its entirety.

In some embodiments, the positive electrode includes a current collector and a positive electrode active material layer positioned on the current collector. A positive electrode active material includes at least one lithiated intercalation compound for reversible intercalation/deintercalation of lithium ions. In some embodiments, the positive electrode active material includes a composite oxide. In some embodiments, the composite oxide contains lithium and at least one element selected from cobalt, manganese and nickel.

In some embodiments, the positive electrode active material is selected from one or more of a lithium cobalt oxide, lithium manganate, a lithium nickel oxide or a lithium nickel manganese cobalt ternary material. The negative electrode active material contains silicon or silicon-oxygen materials, and may also be optionally selected from any of negative electrode materials capable of realizing deintercalation of lithium, such as graphite, hard carbon and mesocarbon microbeads.

In some embodiments, the positive electrode active material may be provided with a coating on the surface, or may be mixed with another compound with a coating. The coating may include at least one coating element compound selected from an oxide of a coating element, a hydroxide of the coating element, an oxyhydroxide of the coating element, an oxycarbonate of the coating element and a hydroxycarbonate of the coating element. The compound used for the coating may be amorphous or crystalline.

In some embodiments, the coating element contained in the coating may include Mg, Al, Co, K, Na, Ca, Si, Ti, V, Sn, Ge, Ga, B, As, Zr or any combination thereof. The coating may be applied by any method as long as the method does not adversely affect the performance of the positive electrode active material. For example, the method may include any coating method

known in the art, such as spray coating and dipping.

The positive electrode active material layer further includes a binder, and optionally includes a conductive material. The binder increases binding of positive electrode active material particles to each other and binding of the positive electrode active material and the current collector.

In some embodiments, the binder includes, but is not limited to, polyvinyl alcohol, hydroxypropyl cellulose, diacetyl cellulose, polyvinyl chloride, carboxylated polyvinyl chloride, polyvinyl fluoride, an ethylene-oxide-containing polymer, polyvinylpyrrolidone, polyurethane, polytetrafluoroethylene, poly(1,1-difluoroethylene), polyethylene, polypropylene, styrene butadiene rubber, acrylated styrene butadiene rubber, epoxy resin, nylon, etc.

In some embodiments, the conductive material includes, but is not limited to, a carbon-based material, a metal-based material, a conductive polymer and a mixture thereof. In some embodiments, the carbon-based material is selected from natural graphite, artificial graphite, carbon black, acetylene black, Ketjen black, carbon fiber or any combination thereof. In some embodiments, the metal-based material is selected from metal powder, metal fiber, copper, nickel, aluminum and silver. In some embodiments, the conductive polymer is a polyphenylene derivative.

In some embodiments, the current collector may be aluminum, but is not limited thereto.

The positive electrode may be prepared by a preparation method known in the art. For example, the positive electrode may be obtained by the following method: mixing the active material, the conductive material and the binder in a solvent to prepare an active material composition, and applying the active material composition to the current collector. In some embodiments, the solvent may include N-methylpyrrolidone and the like, but is not limited thereto.

In some embodiments, the positive electrode is prepared by forming a positive electrode material on the current collector by using a positive electrode active substance layer including lithium-transition metal compound powder and an adhesive.

In some embodiments, the positive electrode active substance layer may be generally prepared through the following operation: performing dry mixing on the positive electrode material and the adhesive (and a conductive material, a thickener, etc., used if needed) to form flakes, and pressing the obtained flakes on the current collector of the positive electrode; or dissolving or dispersing the materials in a liquid medium to form slurry, applying the slurry to the current collector of the positive electrode, and performing drying. In some embodiments, the material

of the positive electrode active substance layer includes any material known in the art.

Separator

In some embodiments, the electrochemical device of the present application is provided with a separator between the positive electrode and the negative electrode to prevent short circuit. The material and shape of the separator used in the electrochemical device of the present application are not particularly limited, and may be any relevant techniques disclosed in the prior art. In some embodiments, the separator includes a polymer or an inorganic material and the like formed by a material stable in the electrolyte of the present application.

For example, the separator may include a substrate layer and a surface treatment layer. The substrate layer is a nonwoven fabric of a porous structure, a film or a composite film, and the material of the substrate layer is at least one selected from polyethylene, polypropylene, polyethylene terephthalate and polyimide. Specifically, a porous polypropylene film, a porous polyethylene film, a polypropylene nonwoven fabric, a polyethylene nonwoven fabric, or a porous polypropylene-polyethylene-polypropylene composite film may be selected and used. The substrate layer may be one layer or multiple layers. When the substrate layers are multiple layers, composition of polymers of different substrate layers may be identical or different, and weight-average molecular weights are different; and when the substrate layers are multiple layers, shutdown temperatures of the polymers of different substrate layers are different.

A surface treatment layer is arranged on at least one surface of the substrate layer, and the surface treatment layer may be a polymer layer or an inorganic material layer, or may be a layer formed by mixing a polymer and an inorganic material.

The inorganic material layer includes inorganic particles and an adhesive. The inorganic particles are selected from one or a combination of several of aluminum oxide, silicon oxide, magnesium oxide, titanium oxide, hafnium oxide, tin oxide, cerium oxide, nickel oxide, zinc oxide, calcium oxide, zirconium oxide, yttrium oxide, silicon carbide, boehmite, aluminum hydroxide, magnesium hydroxide, calcium hydroxide and barium sulfate. The adhesive is selected from one or a combination of several of polyvinylidene fluoride, vinylidene fluoride-hexafluoropropylene copolymers, polyamide, polyacrylonitrile, polyacrylate, polyacrylic acid, polyacrylate, polyvinylpyrrolidone, polyvinyl ether, polymethyl methacrylate, polytetrafluoroethylene and polyhexafluoropropylene. The polymer layer includes a polymer, and the material of the polymer includes at least one of polyamide, polyacrylonitrile, acrylate polymers, polyacrylic acid, polyacrylate, polyvinylpyrrolidone, polyvinyl ether, polyvinylidene fluoride or poly(vinylidene fluoride-hexafluoropropylene).

3. Application

The electrochemical device according to embodiments of the present application has improved cycle performance and high-temperature stability characteristics under an over-discharge condition, and is suitable to be used in various electronic devices.

The purpose of the electrochemical device of the present application is not particularly limited, and the electrochemical device can be used for various known purposes, for example, a notebook computer, a pen input computer, a mobile computer, an e-book player, a portable phone, a portable fax machine, a portable copy machine, a portable printer, stereo headphones, a video recorder, a liquid crystal display television, a portable cleaner, a portable CD player, a mini disk, a transceiver, an electronic notebook, a calculator, a memory card, a portable recorder, a radio, a backup power supply, a motor, a car, a motorcycle, a power bicycle, a bicycle, a lighting fixture, a toy, a game console, a clock, an electric tool, a flash lamp, a camera, a large household storage battery or a lithium-ion capacitor, etc.

Examples

Hereinafter, the present application will be specifically illustrated by way of examples and comparative examples. However, the present application is not limited thereto as long as they do not deviate from the spirit of the present application.

1. Preparation of lithium-ion battery

(1) Preparation of negative electrode

(i) Negative electrode with tab formed by welding

Artificial graphite powder, sodium carboxymethylcellulose (CMC) and styrene butadiene rubber were dissolved in water according to a mass ratio of 96:2:2 to obtain a negative electrode slurry through sufficient mixing and stirring; the negative electrode slurry was uniformly applied onto a specific region of a 12 micron-thick copper foil of a current collector of a negative electrode; baking was performed at 120°C for 1 hour to obtain a negative electrode active material layer; and then, the negative electrode was obtained through compaction, splitting, and tab-welding.

(ii) Negative electrode with tab formed by cutting

Artificial graphite powder, sodium carboxymethylcellulose (CMC) and styrene butadiene rubber were dissolved in water according to a mass ratio of 96:2:2 to obtain a negative electrode

slurry through sufficient mixing and stirring; the negative electrode slurry was uniformly applied onto a specific region of a 12 micron-thick copper foil of a current collector of a negative electrode; baking was performed at 120°C for 1 hour to obtain a negative electrode active material layer; and then, the negative electrode was obtained through compaction, tab-cutting, and splitting.

(iii) Preparation method of negative electrode (Example 59) with polymer adhesive tape on second region of negative electrode

Artificial graphite powder, sodium carboxymethylcellulose (CMC) and styrene butadiene rubber were dissolved in water according to a mass ratio of 96:2:2 to obtain negative electrode slurry through sufficient mixing and stirring; the negative electrode slurry was uniformly applied onto a specific region of a 12 micron-thick copper foil of a current collector of a negative electrode; baking was performed at 120°C for 1 hour to obtain a negative electrode active material layer; and then, the negative electrode was obtained through compaction, splitting, tab-welding, and sticking of a polymer adhesive tape made of acrylic ester onto a second region (i.e., the region not coated with the negative electrode slurry).

(iv) Preparation method of negative electrode (Example 60) with polymer adhesive tape at welding position of tab

Artificial graphite powder, sodium carboxymethylcellulose (CMC) and styrene butadiene rubber were dissolved in water according to a mass ratio of 96:2:2 to obtain a negative electrode slurry through sufficient mixing and stirring; the negative electrode slurry was uniformly applied onto a specific region of a 12 micron-thick copper foil of a current collector of a negative electrode; baking was performed at 120°C for 1 hour to obtain a negative electrode active material layer; and then, the negative electrode was obtained through compaction, splitting, tab-welding, and sticking of a polymer adhesive tape made of acrylic ester onto a welding region of a tab.

(2) Preparation of positive electrode

(i) Positive electrode with tab formed by welding

A positive electrode active material of lithium cobalt oxide (molecular formula: LiCoO_2), an adhesive of polyvinylidene fluoride (PVDF) and conductive graphite (Super-P) were dissolved in N-methylpyrrolidone (NMP) according to a mass ratio of 96:2:2 to obtain a positive electrode slurry through uniform mixing. The positive electrode slurry was uniformly applied onto an aluminum foil (having a thickness of about 12 micron) that acts as the current collector of the

positive electrode. A positive electrode active material layer was obtained after baking at 120°C for 1 hour, and then, the positive electrode was obtained through compaction, tab-welding and splitting.

(ii) Positive electrode with tab formed by cutting

A positive electrode active material of lithium cobalt oxide (molecular formula: LiCoO_2), an adhesive of polyvinylidene fluoride (PVDF) and conductive graphite (Super-P) were dissolved in N-methylpyrrolidone (NMP) according to a mass ratio of 96:2:2 to obtain a positive electrode slurry through uniform mixing. The positive electrode slurry was uniformly applied onto a 12 micron-thick aluminum foil that acts as the current collector of the positive electrode. A positive electrode active material layer was obtained after baking at 120°C for 1 hour, and then, the positive electrode was obtained through compaction, tab-cutting and splitting.

(3) Preparation of electrolyte

In a dry argon gas atmosphere glovebox, ethylene carbonate (EC), propylene carbonate (PC) and diethyl carbonate (DEC) were mixed according to a mass ratio of 3:1:7; LiPF_6 was added as a lithium salt, specific types and quantities of additives (the types and the quantities of added substances were shown in Table 1, and the content of each ingredient in the electrolyte was obtained on the basis of the total weight of the electrolyte) were added. The concentration of LiPF_6 in the electrolyte was about 1 mol/L.

(4) Preparation of separator

A polypropylene separator having a thickness of about 12 microns was selected.

(5) Preparation of lithium-ion battery

The positive electrode, the separator and the negative electrode were sequentially stacked, so that the separator was positioned between the positive electrode and the negative electrode to achieve an isolation effect. Then, the obtained structure was wound and charged into an aluminum foil packaging bag. After baking at 80°C to remove water, a corresponding electrolyte was injected. Through work procedures of vacuum encapsulation, still standing, formation, shaping and the like, a lithium-ion battery was obtained.

2. Test on copper foil used as current collector of negative electrode

Copper foil thickness test: An average value was taken after five points were measured by a micrometer.

Mass per unit area: The copper foil was cut into 100mm×100 mm wide flakes and weighed, for calculating the mass per unit area. Mass per unit area=weight/area.

Tensile strength test: A tensile testing machine was used for testing. The length of a test sample was 200 ± 0.5 mm, the width of the test sample was 15 ± 0.25 mm, a tensile speed was set to be 50 mm/min, and the chuck distance of the testing machine was 125 ± 0.1 mm. Five parallel samples were tested, and an average value was taken as a test result. During the test, the length direction of the test sample was parallel to the axial line of a clamp, the sample was maintained at a linear state, and an experiment temperature was $20\pm5^{\circ}\text{C}$.

Elongation rate test: A tensile testing machine was used for testing. The length of a test sample was 200 ± 0.5 mm, the width of the test sample was 15 ± 0.25 mm, a tensile speed was set to be 50 mm/min, the chuck distance of the testing machine was 125 ± 0.1 mm. Five parallel samples were tested, and an average value thereof was taken as a test result. During the test, the length direction of the test sample was parallel to the axial line of a clamp, the sample was maintained at a linear state, and the experiment temperature was $20\pm5^{\circ}\text{C}$. Elongation rate=tensile length/original length.

3. Performance test of lithium-ion battery

(1) Cycle performance test

A lithium-ion battery was charged to 4.45 V at a 1 C constant current under the condition of 45°C , stood for 30 minutes, and then discharged at 1 C to 3.0 V. The lithium-ion battery was cyclically charged and discharged for 500 times.

Capacity retention rate (%) of lithium-ion battery = discharge capacity after 500 cycles /initial discharge capacity $\times 100\%$.

(2) 60°C high-temperature storage test

The lithium-ion battery was put into a 25°C incubator, and was charged to 3.95 V at a 0.5 C constant current; and the thickness of the battery was tested. Then, the battery was fully charged to 4.45 V. The battery was put into a 60°C oven and stored for 30 days. During this period, the thickness of the battery was tested every 3 days. If the thickness increase rate of the battery relative to that under the condition of 3.95 V is greater than 60%, the test was stopped.

Thickness increase rate = (thickness after storage-thickness under the condition of 3.95 V) / thickness under the condition of 3.95 V $\times 100\%$.

(3) Floating charging leakage current test

The lithium-ion battery was stood for 120 minutes under the condition of 45°C, was charged to 4.45 V at 1 C, and was maintained at a constant-voltage charge state for 15 days. The magnitude of the current after the 15 days was recorded.

(4) Battery extrusion test

The lithium-ion battery was put into a 25°C incubator, charged to 4.45 V at a 0.5 C constant current, and was then charged at a constant voltage to reach a 0.05 C current. Then, the battery was extruded by a 20 KN pressure, and whether combustion or explosion occurred to the battery was observed.

A. The electrolytes and the lithium-ion batteries in Examples 1-39 and Comparative Examples 1-6 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.5\%$, a thickness of 6 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 3\%$. B% (*i.e.*, the proportion of the area of a second region in the surface area of the negative electrode) was 18.2%, and the tab was connected to the second region by welding. The width W of the tab was 0.8 cm. The distance C between the tab and the edge of the current collector was 2 cm. The width D of an edge folded region of the second region located at the edge of the current collector was 1.8 cm. Tab of the positive electrode was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. Test results are shown in Table 1.

Table 1

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	Proportion of area of second region in surface area of current collector B (%)	Ax B	Capacity retention rate (%)	Floating charging leakage current (mA)	60°C high-temperature storage test (%)
Example 1	Compound 1	0.3	18.2	5.46	70	4	48
Example 2	Compound 1	1	18.2	18.2	78	5	35
Example 3	Compound 1	3	18.2	54.6	75	7	15

Example 4	Compound 1	5	18.2	91	74	9	14
Example 5	Compound 1	10	18.2	182	67	20	14
Example 6	Compound 2	1	18.2	18.2	87	6	33
Example 7	Compound 2	3	18.2	54.6	86	8	15
Example 8	Compound 2	10	18.2	182	72	18	14
Example 9	Compound 3	0.3	18.2	5.46	72	4	47
Example 10	Compound 3	1	18.2	18.2	84	7	36
Example 11	Compound 3	3	18.2	54.6	79	9	18
Example 12	Compound 3	10	18.2	182	72	23	18
Example 13	Compound 5	0.3	18.2	5.46	70	3	50
Example 14	Compound 5	1	18.2	18.2	82	5	32
Example 15	Compound 5	3	18.2	54.6	81	6	13
Example 16	Compound 5	5	18.2	91	75	9	10
Example 17	Compound 5	10	18.2	182	70	19	10
Example 18	Compound 6	1	18.2	18.2	81	3	23
Example 19	Compound 6	3	18.2	54.6	81	4	14
Example 20	Compound 6	10	18.2	182	70	23	14
Example 21	Compound 7	0.3	18.2	5.46	70	3	51
Example 22	Compound 7	1	18.2	18.2	85	5	35
Example 23	Compound 7	3	18.2	54.6	83	6	13
Example 24	Compound 7	10	18.2	182	70	19	13
Example 25	Compound 1+ Compound 2	1.5+1.5	18.2	54.6	81	5	37
Example 26	Compound 1+ Compound 3	1.5+1.5	18.2	54.6	83	4	35
Example 27	Compound 1+ Compound 4	1.5+1.5	18.2	54.6	81	5	34
Example	Compound 1+	1.5+1.5	18.2	54.6	83	3	35

28	Compound 5						
Example 29	Compound 1+ Compound 6	1.5+1.5	18.2	54.6	87	3	33
Example 30	Compound 1+ Compound 7	1.5+1.5	18.2	54.6	85	3	37
Example 31	Compound 2+ Compound 5	1.5+1.5	18.2	54.6	83	5	34
Example 32	Compound 2+ Compound 6	1.5+1.5	18.2	54.6	83	8	35
Example 33	Compound 2+ Compound 7	1.5+1.5	18.2	54.6	81	4	30
Example 34	Compound 3+ Compound 6	1.5+1.5	18.2	54.6	80	5	37
Example 35	Compound 3+ Compound 7	1.5+1.5	18.2	54.6	85	4	35
Example 36	Compound 1+ Compound 2+ Compound 3	1+1+1	18.2	54.6	81	3	35
Example 37	Compound 2+ Compound 4+ Compound 5	1+1+1	18.2	54.6	84	2.9	35
Example 38	Compound 3+ Compound 4+ Compound 6	1+1+1	18.2	54.6	84	4	36
Example 39	Compound 5+ Compound 6+ Compound 7	1+1+1	18.2	54.6	87	4	36
Comparative example 1	/	0	18.2	0	61	2.5	Test stopped due to serious gas expansion
Comparative example 2	Compound 2	12	18.2	218. 2	56	45	20
Comparative example 3	Compound 3	12	18.2	218. 2	54	38	23
Comparative example 4	Compound 5	12	18.2	218. 2	56	43	21
Comparative example 5	Compound 6	12	18.2	218. 2	59	36	18
Comparative example 6	Compound 7	15	18.2	345	51	51	19

Note: "/" represents absent.

Table 1 shows examples and comparative examples wherein B% (the proportion of the area of the second region in the surface area of the negative electrode) was fixed to be 18.2%. Compared with Comparative Example 1 wherein no nitrile compound was added to the electrolyte, Examples 1 to 39, in which a specific nitrile compound ranging from 0.1 wt% to 10 wt% was added into the electrolyte, show significantly improved cycle performance. From Comparative Examples 2 to 5 and Comparative Example 1, it can be seen that when increasing the content of the nitrile compound to 12 wt% so that the value of A times B reaches 218.2, the cycle performance was improved compared with that of Comparative Example 1, but the degree of improvement was reduced; and meanwhile, battery self-discharging was further improved. From Comparative Example 6, it can be seen that when increasing the content of the nitrile compound to 15% so as to make the product of A and B be greater than 210, the floating charging leakage current exceeded 50 mA, which seriously affected the function of the battery. Therefore, for conditions where the electrolyte contains 0.1 wt% to 10 wt% of the specific nitrile compound, when the tab and the second region is connected by welding, making the value of A times B be less than 210 can improve battery performance and meanwhile introduce small self-discharging. Addition of the nitrile compound can improve cycle performance because nitrile groups can complex with metal ions on the positive electrode and stabilize potential of the metal ions, thereby reducing phase changing of the structure of the positive electrode material. Meanwhile, the nitrile compound can adhere on the surface of the positive electrode to decrease contact between the positive electrode and the electrolyte. Due to a combination of the two effects, the cycle and floating charging performances of the battery can be significantly improved. However, the nitrile compound may cause a certain degree of dissolution of the copper foil current collector of the negative electrode. Particularly when a copper foil current collector with no active substance on its surface is exposed in the electrolyte, the dissolution of the copper foil caused by the nitrile compound is greatly enhanced. Dissolved copper ions can be slowly reduced into elemental copper and continuously deposited on the surface of the negative electrode during the charging and discharging process of the battery, which finally would cause a local short circuit and deteriorate the self-discharging of the battery. Although the nitrile compound may deteriorate self-discharging of a battery, it can improve electric performance of the battery. Therefore, it is necessary to add a certain content of nitrile compound into the electrolyte, and control the area of the exposed bare copper foil within a certain range, in order to control both the electric performance and self-discharging of the battery.

B. The electrolytes and the lithium-ion batteries in Examples 40 to 52 and Comparative Example 8 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil

had a purity of $\geq 99.8\%$, a thickness of 8 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 3\%$. The tab and the second region were connected by welding. The width W of the tab was 0.8 cm; the distance C between the tab and the edge of the current collectors was 2 cm; the width D of the edge folded region of the second region located at the edge of the current collector was 2.5 cm. The tab of the positive electrode was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 2.

Table 2

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	Proportion of area of second region in surface area of current collector B (%)	Ax B	Capacity retention rate (%)	Floating charging leakage current (mA)	60°C high-temperature storage test (%)
Example 40	Compound 2	3	9.1	27.3	83	8	32
Example 41	Compound 3	3	17.6	52.8	88	8	32
Example 42	Compound 4	3	21.9	65.7	88	15	30
Example 43	Compound 5	3	23	69	86	16	35
Example 44	Compound 6	3	27	81	85	17	34
Example 45	Compound 7	3	31	93	81	11	34
Example 46	Compound 2+ Compound 3	1.5+1.5	17.6	52.8	81	6	37
Example 47	Compound 3+ Compound 4	1.5+1.5	17.6	52.8	81	3	34
Example 48	Compound 3+ Compound 5	1.5+1.5	21.9	65.7	81	6	36
Example 49	Compound 3+ Compound 5+ Compound 7	1+1+1	23	69	81	21	36
Example	Compound	1+1+1	23	69	81	23	35

50	2+ Compound 4+ Compound 5						
Example 51	Compound 2+ Compound 4+ Compound 6	1+1+1	23	69	81	23	35
Example 52	Compound 2	3	0.4	1.2	82	0.6	35
Comparative example 8	Compound 2	3	85	255	70	47	37

Table 2 shows examples and comparative examples with the content of the nitrile compound in the electrolyte being 3 wt%. As shown in Examples 40 to 51, when the content of the nitrile compound in the electrolyte was fixed to 3 wt%, the cycle and storage performances of the batteries were good. With adjustment of the area of the second region of the negative electrode in the battery to increase the value of A times B, the floating charging leakage current of the batteries was increased. As shown in Comparative Example 8, when the value of A times B exceeds 210, serious self-discharging occurred, which affected the function of the batteries. The current collector of the negative electrode in Example 52 did not include a second region (i.e., B is 0.4), so that the value of A times B is 1.2. Compared with Comparative Example 8, the battery of Example 52 achieved better cycle performance and smaller leakage current.

C. The electrolytes and the lithium-ion batteries in Examples 53 to 60 and Comparative Example 9 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of $\geq 30 \text{ kg/mm}^2$, and an elongation rate of $\geq 2\%$. The tab and the second region were connected through cutting; the number of the tabs was 9, the width W of the tab was 1.5 cm; the width D of the edge folded region of the second region positioned at the edge of the current collector was 1.5 cm. The tab of the positive electrode was correspondingly prepared by cutting. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 3.

Table 3

	Nitrile compound	Mass percentage of nitrile	Proportion of area of second	AxB	Capacity retention	Floating charging	60°C high-temperature
--	------------------	----------------------------	------------------------------	-----	--------------------	-------------------	-----------------------

		compound in electrolyte A (%)	region in surface area of current collector B (%)		n rate (%)	ng leakag e curren t (mA)	ure storage test (%)
Example 53	Compound 1	3	18.1	54.3	83	2	34
Example 54	Compound 2	3	22.5	67.5	85	3	28
Example 55	Compound 4	3	36.7	110.1	86	6	29
Example 56	Compound 5	3	54	162	83	21	32
Example 57	Compound 1+ Compound 2	1.5+1.5	18.1	54.3	84	4	33
Example 58	Compound 2+ Compound 4	1.5+1.5	18.1	54.3	81	3	33
Example 59	Compound 2+ Compound 4+ Compound 5	1.5+1.5+1.5	18.1	54.3	83	4	26
Example 60	Compound 2	3	2.3	6.9	83	0.2	31
Comparative example 9	Compound 5	12	54	648	80	40	15

As shown in Table 3, in Examples 53 to 60 and Comparative Example 9, the tabs of the batteries were all prepared by cutting. Examples 53 to 59 show that adjustment of B% (*i.e.*, the proportion of the area of the second region) did not seem to significantly affect the capacity retention rate of the battery, but increased self-discharging of the battery. In Comparative Example 9 where A% (the mass percentage of the nitrile compound) was 12 wt% and B% (the proportion of the area of the second region) was 54% so that the value of A times B was 648, the self-discharging current reached 40 mA. The current collector of the negative electrode in Example 60 was completely coated with an active material, but no active material was applied to the tabs (*i.e.*, B%=2.3%, which is the proportion of a bare copper foil at the positions of the tabs), so that the value of A times B is 6.9. Compared with Comparative Example 9, the battery of Example 60 achieved better cycle and storage performances and smaller leakage current. In view of the

above, when preparing the tabs of the batteries by cutting, the value of A times B should be controlled within 600 to arrive at good battery performance.

D. The electrolytes and the lithium-ion batteries in Examples 61 to 63 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 2\%$. The tab and the second region were connected by welding. The width of the tab was 0.8 cm. The distance C between the tab and the edge of the current collector was 2 cm. The width D of the edge folded region of the second region positioned at the edge of the current collector was 1.8 cm. The tabs of the positive electrode were correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 4.

Table 4

	Nitrile compound	Mass percentage of nitrile compound in electrolyte	AxB	Capacity retention rate (%)	Floating charging leakage current (mA)	60°C high-temperature storage test (%)
	d	A (%)				
Example 61	Compound 1	3	42	85	4	35
Example 62	Compound 1	3	75	84	8	34
Example 63	Compound 1	3	76.8	85	12	34

As shown in Table 4, in Example 61, the copper foil region not coated with the active substance layer was covered by a certain area of a polymer adhesive tape so as to reduce the contact area between the copper foil and the electrolyte. Compared with Example 63 which did not use the polymer adhesive tape, Example 61 achieved lower leakage current. In Example 62, the welding position of the tab was covered with a certain area of a polymer adhesive tape. Compared with Example 63 which did not use the polymer adhesive tape, the self-discharging of the battery of Example 62 was decreased. Therefore, in practical battery design, the welding position of the tab on the copper foil current collector of the negative electrode and other bare copper foil regions not coated with negative electrode active substances can be covered with a polymer adhesive tape or another substance capable of being bond onto the copper foil and tab, in order to reduce self-discharging of the battery.

E. The electrolytes and the lithium-ion batteries in Examples 64 to 70 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 2\%$. The tab and the second region were connected by welding; the width of the tab was 0.8 cm; the distance C between the tab and the edge of the current collector was 2 cm; and the width D of the edge folded region of the second region positioned at the edge of the current collectors was 1.8 cm. The tab of the positive electrode was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 5.

Table 5

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	Other additives and mass percentage thereof in electrolyte (%)	A* B	Capacity retention rate (%)	Floating charging leakage current (mA)	60°C high-temperature storage test (%)
Example 64	Compound 1	3	PS 1	52.5	87%	5	25
Example 65	Compound 2	3	FEC+PS 1+1	52.5	84%	3	23
Example 66	Compound 4	3	PS+VC 1+0.5	52.5	86%	2.4	17
Example 67	Compound 5	3	DTD+SA 1+0.5	52.5	86%	8	16
Example 68	Compound 2	3	MMDS+V C 0.5+0.5	52.5	85%	7	17
Example 69	Compound 4	3	PS+VC+D TD 1+0.5+1	52.5	88%	10	15
Example 70	Compound 1	3	/	52.5	75%	11	36

Note: "/" represents not added.

From Examples 64 to 69 and Example 70, it can be seen that addition of other additives in the electrolyte containing specific nitride compounds can significantly improve the cycle performance and floating charging thickness increase rate of batteries. The addition of FEC can increase the LiF content of the negative electrode SEI, and can improve stability of the negative electrode SEI. The addition of VC can facilitate the formation of a reticular protection layer at

the surface layer of SEI through polymerization, and can increase flexibility of SEI. Addition of other additives can stabilize or strengthen the SEI protection layer to a certain degree. Therefore, the cycle performance of battery was improved. Meanwhile, due to a film forming effect of the additives on the negative electrode, deposition of copper ions on the negative electrode can be reduced to a certain degree, self-discharging of the battery can be reduced, which further improved the overall electric performance of the battery.

Therefore, it can be seen from the examples and the comparative examples that the nitrile compound as an effective additive for improving the cycle stability has great influence on the self-discharging of the battery. In order to improve the long-term storage performance of the battery, it is necessary to control the content of the nitrile compound and the area of the bare copper foil region within a certain range so as to ensure that the capacity of the battery would not be significantly reduced after long-term storage. Meanwhile, through addition of a certain content of other additives into the electrolyte, the cycle performance and self-discharging of the battery can be improved, and the long-term cycle and storage of the battery can be ensured.

F. The electrolytes and the lithium-ion batteries in Examples 71 to 72 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 2\%$. The tab and the second region were connected by welding. The width W of the tabs was 0.8 cm. The distance C between the tab and the edge of the current collectors was 2 cm. In Example 71, the width D of the edge folded region of the second region positioned at the edge of the current collector was 1.8 cm. In Example 72, the edge of the second region positioned at the edge of the current collector was not folded. The positive electrode tab was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 6.

Table 6

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	AxB	Capacity retention rate (%)	Floating charging leakage current (mA)	Extrusion test
Example 71	Compound 2	3	52.5	84%	5	No combustion occurred

Example 72	Compound 2	3	52.5	83%	6	Combustion occurred
-------------------	------------	---	------	-----	---	---------------------

As shown in Table 6, in Example 71, the edge of the second region positioned at the edge of the current collector was folded; and in Example 72 the edge of the second region positioned at the edge of the current collector was not folded. The capacity retention rates and the floating charging leakage current of Example 71 and Example 72 did not show obvious differences, but the extrusion test showed that the risk of piercing the separator by burrs in the welding position of the tab was reduced due to the folding, which made the battery achieve better safety performance.

G. The electrolytes and the lithium-ion batteries in Examples 73 to 76 were prepared according to the above methods, wherein the current collector of the negative electrode was a copper foil generated through electrolysis. The copper foil had a purity of $\geq 99.8\%$, a thickness of 6 microns, a tensile strength of ≥ 30 kg/mm², and an elongation rate of $\geq 2\%$. The tab and the second region were connected by welding. The width W of the tab was 0.8 cm. The distance C between the tab and the edge of the current collector was 2 cm. The width D of the edge folded region of the second region positioned at the edge of the current collector was 1.8 cm. The tab of the positive electrode was correspondingly prepared by welding. The cycle capacity retention rate after certain cycles, the floating charging leakage current and the 60°C high-temperature storage test of the lithium-ion batteries were tested. The test results are shown in Table 7.

Table 7

	Nitrile compound	Mass percentage of nitrile compound in electrolyte A (%)	AxB	Cl ⁻ content (ppm)	Capacity retention rate (%)	Floating charging leakage current (mA)
Example 73	Compound 5	3	36.9 %	100	81%	7
Example 74	Compound 5	3	36.9 %	500	82%	6
Example 75	Compound 5	3	36.9 %	1000	80%	5
Example 76	Compound 5	3	36.9 %	1100	75%	4

As shown in Table 7, addition of a proper amount of an anion (e.g., Cl⁻) in the electrolyte can improve leakage current of the battery. However, high amount of the anion (e.g., exceeding

1000 ppm) would greatly affect the capacity retention rate of the battery. Therefore, while ensuring the electric performance of the battery, a proper amount of the anion may be added into the electrolyte to improve the floating charging leakage current.

The foregoing descriptions are merely a few embodiments of the present application and are not intended to limit the present application in any manner. Although the present application is described with reference to preferred embodiments, the embodiments are not intended to limit the present application.

Throughout the specification, references to "embodiment," "part of embodiments," "one embodiment," "another example," "example," "specific example" or "part of examples" mean that at least one example or example of the present application includes specific features, structures, materials or characteristics described in the embodiment or example. Thus, the descriptions appear throughout the specification, such as "in some embodiments," "in an embodiment," "in one embodiment," "in another example," "in an example," "in a particular example" or "for example," are not necessarily the same embodiment or example in the application. Furthermore, the specific features, structures, materials or characteristics in the descriptions can be combined in any suitable manner in one or more embodiments or examples.

Although the illustrative embodiments have been shown and described, it should be understood by those skilled in the art that the above embodiments cannot be interpreted as limitations to the present application, and the embodiments can be changed, substituted and modified without departing from the spirit, principle and scope of the present application.

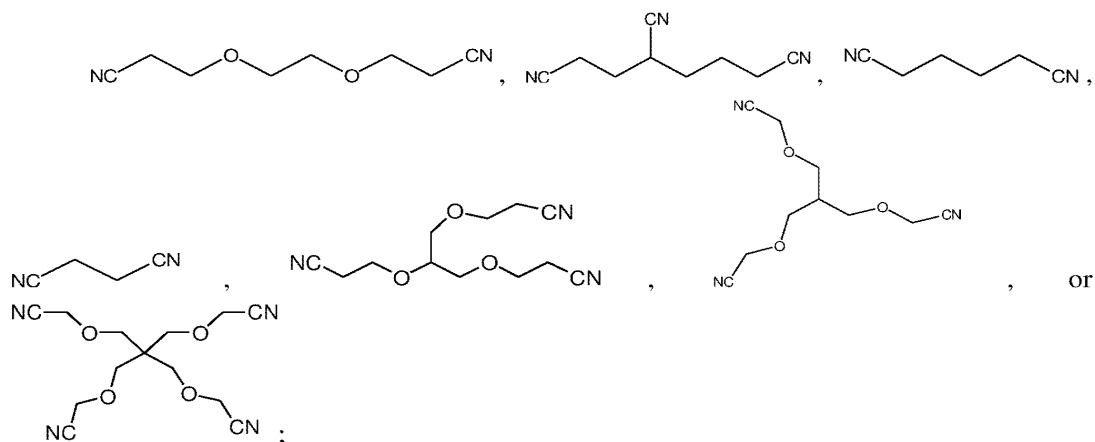
CLAIMS

What is claimed is:

1. An electrochemical device, comprising: a positive electrode, a negative electrode, a separator and an electrolyte; wherein

the electrolyte comprises a nitrile compound, wherein

the nitrile compound comprises at least one of:



and a mass percentage of the nitrile compound in the electrolyte is A%;

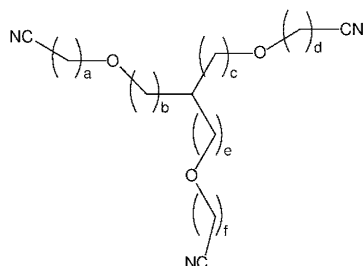
the negative electrode comprises a current collector, wherein the current collector comprises a first region and a second region;

a negative electrode active substance layer is provided only in the first region;

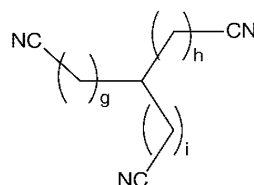
an area of the second region is B% of the surface area of the current collector; and

$A \times B < 600$.

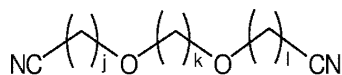
2. The electrochemical device according to claim 1, wherein the nitrile compound comprises at least one of a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V or a compound of Formula VI:



Formula I,



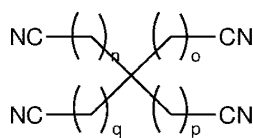
Formula II,



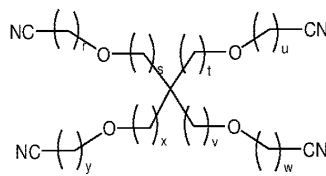
Formula III,



Formula IV,



Formula V, and



Formula VI,

wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is an integer independently selected from 0 to 5; and the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%.

3. The electrochemical device according to claim 1, wherein the negative electrode comprises at least one tab, the tab is formed by being connected to the second region through welding, and $A \times B < 210$.

4. The electrochemical device according to claim 1, wherein the negative electrode comprises at least one tab, the tab is formed by cutting the current collector, the tab comprises a region not coated with the negative electrode active substance layer, and $A \times B < 500$.

5. The electrochemical device according to claim 3, wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to an edge of the current collector and the edge of the current collector is C, and $0 \leq C/\text{tab width} \leq 50$.

6. The electrochemical device according to claim 4, wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to the edge of the current collector and the edge of the current collector is C, and $0 \leq C/\text{tab width} \leq 50$.

7. The electrochemical device according to claim 1, wherein at least one of the second region is positioned at the edge of the current collector, and an edge of the second region positioned at the edge of the current collector is either folded or not folded, wherein when the edge of the second region positioned at the edge of the current collector is folded, a width of the folded region is D, and $0.1 \leq D/\text{tab width} \leq 20$.

8. The electrochemical device according to claim 1, wherein the current collector is a copper foil and the copper foil has one or more of the following properties:

- a copper purity of $\geq 99.5\%$,
- a thickness of 3 microns to 15 microns,
- a weight per unit area of 30 g/m^2 to 150 g/m^2 ,
- a tensile strength of $\geq 20 \text{ kg/mm}^2$, and
- an elongation rate of $\geq 1.5\%$.

9. The electrochemical device according to claim 1, wherein the second region is covered by a substance adhered onto the second region.

10. The electrochemical device according to claim 3, wherein a position of the at least one tab is covered by a substance bond onto the position of the tab.

11. The electrochemical device according to claim 4, wherein a position of the at least one tab is covered by a substance bond onto the position of the tab.

12. The electrochemical device according to claim 1, wherein the electrolyte further comprises an additive, and the additive comprises at least one of the following: 1,3-propane sultone, fluoroethylene carbonate, vinylene carbonate, 2,4-butane sultone, 1,4-butane sultone, methylene methanedisulfonate, ethylene sulfate, succinic anhydride, ethoxy(pentafluoro)cyclotriphosphazene, 1,3-dioxane, or propenyl-1,3-sultone.

13. The electrochemical device according to claim 1, wherein the electrolyte further comprises an anion, the anion comprises at least one of Cl^- , Br^- , SO_4^{2-} , CO_3^{2-} or F^- , and the content of the anion in the electrolyte is less than or equal to 1000 ppm.

14. An electronic device, comprising an electrochemical device, wherein the electrochemical device comprises a positive electrode, a negative electrode, a separator

and an electrolyte; wherein

the electrolyte comprises a nitrile compound, and a mass percentage of the nitrile compound in the electrolyte is A%;

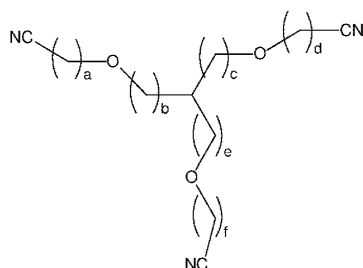
the negative electrode comprises a current collector, wherein the current collector comprises a first region and a second region;

a negative electrode active substance layer is provided only in the first region;

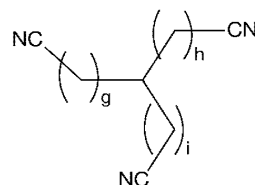
an area of the second region is B% of the surface area of the current collector; and

$A \times B < 600$.

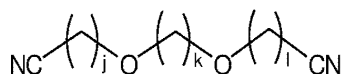
15. The electronic device according to claim 14, wherein the nitrile compound comprises at least one of a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V or a compound of Formula VI:



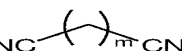
Formula I,



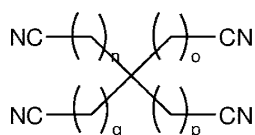
Formula II,



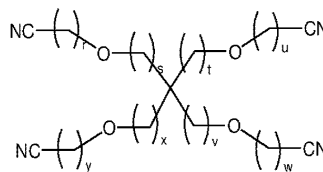
Formula III,



Formula IV,



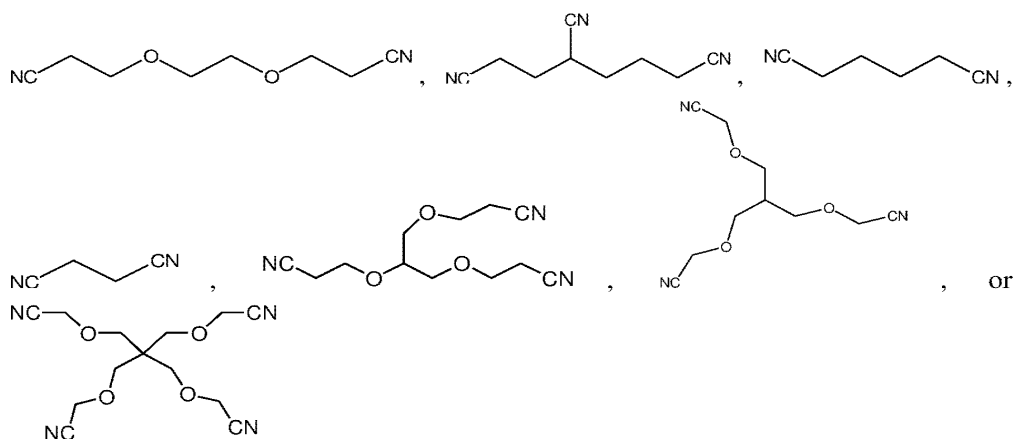
Formula V, and



Formula VI,

wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is an integer independently selected from 0 to 5; and the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%.

16. The electrochemical device according to claim 14, wherein the nitrile compound comprises at least one of:



17. The electrochemical device according to claim 14, wherein the negative electrode comprises a tab, the tab is formed by being connected to the second region through welding, and $A \times B < 210$.

18. The electrochemical device according to claim 14, wherein the negative electrode comprises at least one tab, the tab is formed by cutting the current collector, the tab comprises a region not coated with the negative electrode active substance layer, and $A \times B < 500$.

19. The electrochemical device according to claim 14, wherein the second region is covered by a substance adhered onto the second region.

ABSTRACT

An electrochemical device, including a positive electrode, a negative electrode, a separator and an electrolyte. The electrolyte includes a nitrile compound, and the mass percentage of the nitrile compound in the electrolyte is A%; the negative electrode includes a current collector, wherein the current collector comprises a first region and a second region; the first region is provided with a negative electrode active substance layer; the second region does not comprise a negative electrode active substance layer; the area of the second region is B% of the surface area of the current collector; and $A \times B < 600$

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA/82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number			
Filing Date	March 18, 2024		
First Named Inventor	Lilan ZHANG		
Title	ELECTROLYTE AND ELECTROCHEMICAL DEVICE		
Art Unit	TBD		
Examiner Name	TBD		
Attorney Docket Number	14850267COA		
SIGNATURE of Applicant or Patent Practitioner			
Signature	/Timothy J. Maier/	Date (Optional)	March 18, 2024
Name	Timothy J. Maier	Registration Number	51986
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			
NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.			
☐ *Total of _____ forms are submitted.			

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☒ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above:

62008

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☒ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

Firm or Individual Name				
Address				
City		State		Zip
Country				
Telephone		Email		

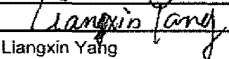
I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Ningde Amperex Technology Limited

- ☐ Inventor or Joint Inventor (title not required below)
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
- ☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	
Name	Liangxin Yang		
Title	IP Senior Manager		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO.	TOT CLAIMS	IND CLAIMS
18/607,737	03/18/2024		1820	14850267COA	19	2

62008

MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

CONFIRMATION NO. 7065

FILING RECEIPT



0000000070302621

Date Mailed: 03/27/2024

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Lilan ZHANG, Ningde, CHINA;
Chao TANG, Ningde, CHINA;
Jianming ZHENG, Ningde, CHINA;

Applicant(s)

Ningde Amperex Technology Limited, Ningde, CHINA;

Assignment For Published Patent Application

Ningde Amperex Technology Limited, Ningde, CHINA

Power of Attorney: The patent practitioners associated with Customer Number 62008

Domestic Priority data as claimed by applicant

This application is a CON of 16/970,864 08/18/2020
which is a 371 of PCT/CN2020/077638 03/03/2020

Foreign Applications for which priority is claimed (You may be eligible to benefit from the Patent Prosecution Highway program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

page 1 of 3

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 03/26/2024

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/607,737**

Projected Publication Date: 07/04/2024

Non-Publication Request: No

Early Publication Request: No

Title

ELECTROLYTE AND ELECTROCHEMICAL DEVICE

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

page 2 of 3

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 18/607,737				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	700			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800			
TOTAL CLAIMS (37 CFR 1.16(i))	19	minus 20 = *	0			x	= 0			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2	minus 3 = *				x	= 0			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0			
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL		TOTAL	1820			
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
TOTAL ADD'L FEE									TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
TOTAL ADD'L FEE									TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.										



United States Patent and Trademark Office

Under Secretary of Commerce for Intellectual Property and
Director of the United States Patent and Trademark Office

WELCOME TO THE UNITED STATES PATENT AND TRADEMARK OFFICE (USPTO)

*Congratulations on taking the first step to protect your invention. You can now advertise or mark any products covered by this application for your invention as **"Patent Pending"** for as long as this application is pending!*

We are here to help you on the rest of your journey.

New to the process? The Patent Basics page will take you from "What is a patent?" to assistance with the application process.

- www.uspto.gov/PatentBasics

Consider cost savings. You might qualify for small entity or micro entity status, which means a discount on most USPTO patent fees.

- www.uspto.gov/EntityStatus

Become a registered electronic filer (eFiler). You'll gain access to the full capabilities of Patent Center. As a registered eFiler, you can electronically view your submission, track the progress of your application, and respond to USPTO correspondence.

- www.uspto.gov/NewPatentFilers

Learn how to identify which of your creative ideas might be intellectual property assets and how to protect them by using the USPTO Intellectual Property (IP) Identifier.

- ipidentifier.uspto.gov

We also provide Pro Se Assistance, support specifically geared for **independent inventors without an attorney or agent**. Follow the link below, call us at 866-767-3848, or email proseassistancecenter@uspto.gov.

- www.uspto.gov/ProSePatents

Need help near you? We have regional offices across the country, as well as Patent and Trademark Resource Centers in libraries in nearly every state, with specialists standing by to help you at no cost.

- www.uspto.gov/locations
- www.uspto.gov/ptrc

Contact us:

- **General information:** USPTO Contact Center
 - www.uspto.gov/help
- **Patent Center:**
Patent Electronic Business Center
 - www.uspto.gov/EBC
- **Pre or post-examination:** Application Assistance Unit
 - www.uspto.gov/PatentAssistance

Want to learn more?

- **Access our free services** all in one spot. Find all of our contact centers, nationwide services, events, education, and training.
 - www.uspto.gov/FreeServices
- **Connect with us** on Instagram, LinkedIn, Twitter, Facebook, and YouTube.
- **Hear about resources for startups, inventors, and entrepreneurs**, as well as our initiatives engaging women, the military community, and others. These programs offer helpful tips and tricks on identifying and managing your IP, finding options for funding, and expanding your network to support your business.
 - www.uspto.gov/startups
 - www.uspto.gov/inventors
 - www.uspto.gov/initiatives
- We hope you connect with us by subscribing to receive important notifications by email.
 - www.uspto.gov/subscribe

Kathi Vidal

Under Secretary of Commerce for Intellectual Property and
Director of the United States Patent and Trademark Office

Derrick Brent

Deputy Under Secretary of Commerce for Intellectual Property and
Deputy Director of the United States Patent and Trademark Office



UNITED STATES DEPARTMENT OF COMMERCE

U.S. Patent and Trademark Office

Address: COMMISSIONER FOR PATENTS

P.O. Box 1450

Alexandria, Virginia 22313-1450

APPLICATION NO./ CONTROL NO.	FILING DATE	FIRST NAMED INVENTOR/ PATENT IN REEXAMINATION	ATTORNEY DOCKET NO.
18/607,737	03/18/2024	ZHANG et al.	14850267COA

MAIER & MAIER, PLLC 345 SOUTH PATRICK STREET ALEXANDRIA, VA 22314		EXAMINER	
		--	
		ART UNIT	PAPER
		--	20240428- 3DZn1w

DATE MAILED: 28 April 2024

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner for Patents

PTO-90C (Rev.04-03)

Notice of Potential Erroneous Release of Patent Application Titles

On February 5, 2024, the United States Patent and Trademark Office (USPTO), replaced the Electronic Patent Assignment System (EPAS) and Electronic Trademark Assignment System (ETAS) with Assignment Center.

Between February 5, 2024 and March 29, 2024, the USPTO, unintentionally, through a computer programming error, permitted bibliographic information to be viewed by unauthorized individuals with access to registered Assignment Center accounts. This bibliographic information was limited to the application number (the two-digit series code plus the six-digit serial number) and title of the invention.

You are receiving this notification because your application's patent title may have been viewed during that time frame by individual(s) who lacked permission to do so. The software error was first reproduced by USPTO on March 28, 2024, and was corrected on March 29, 2024. Only application numbers and titles were disclosed; it is important to note that your specification and claims were not part of the information made available and were not accessed.

Any improper access of the application information between the dates of February 5, 2024 and March 29, 2024, is not considered a publication of such applications under 35 U.S.C. 122(b). No rights in United States patents are threatened by the access to unpublished applications. It is extremely unlikely that the title could disclose the invention in a way that would constitute patent-defeating prior art in any jurisdiction. To the extent any issue is raised, the USPTO will assist applicants by confirming that the disclosure was erroneous and inadvertent.

We're committed to data security and are taking enhanced steps to prevent incidents such as this from happening in the future. The USPTO sincerely regrets this error and is instituting more testing controls, both manual and automated testing, to prevent similar processing errors in the future.

Inquiries regarding this matter may be directed to Mark Polutta, Senior Legal Advisor, at (571) 272-7709 or Andrew Stclair, Legal Advisor, at (571) 270-0238, both of the Office of Patent Legal Administration or via email addressed to Patent.Practice@uspto.gov.



Henry "Jamie" Holcombe
Chief Information Officer
US Patent and Trademark Office
Office +1 (571) 272-9400



Dated: April 27th, 2024



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/607,737	03/18/2024	Lilan ZHANG	14850267COA

CONFIRMATION NO. 7065

62008
MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

PUBLICATION NOTICE



OC00000075442588

Date Mailed: 07/18/2024

Title:ELECTROLYTE AND ELECTROCHEMICAL DEVICE

Publication No.US-2024-0243344-A1

Publication Date:07/18/2024

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be viewed using the USPTO's publicly available Searchable Databases via the Patent Public Search tool at www.uspto.gov. The direct link to access the Patent Public Search tool is currently <https://ppubs.uspto.gov/pubwebapp/static/pages/ppubsbasic.html>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through Patent Center, the USPTO's electronic patent application filing and management system. The direct link to access this status information is currently <https://patentcenter.uspto.gov/>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of Patent Center.

Further assistance in electronically accessing the publication, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

<i>Notice of References Cited</i>	Application/Control No. 18/607,737		Applicant(s)/Patent Under Reexamination ZHANG et al.	
	Examiner KARIE O APICELLA		Art Unit 1725	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Name	CPC Classification	US Classification
*	A	US-9812739-B2	2017-11-07	Kefei; Wang	H01M10/0567	1/1
*	B	US-20060147803-A1	2006-07-06	Kim; Young Soo	H01M4/661	429/231.95
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

U.S. Patent and Trademark Office
PTO-892 (Rev. 11-2023)

Notice of References Cited

Part of Paper No. 20240923

Search Notes 	Application/Control No. 18/607,737	Applicant(s)/Patent Under Reexamination ZHANG et al.
	Examiner KARIE O APICELLA	Art Unit 1725

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
H01M and text-limited search in PE2E SEARCH	09/23/2024	KOA
Inventor and assignee search in DAV	09/23/2024	KOA
NPL search	09/23/2024	KOA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/KARIE O'NEILL APICELLA/ Primary Examiner, Art Unit 1725	
---	--

Doc code: IDS

PTO/SB/08a (01-22)

Doc description: Information Disclosure Statement (IDS) Filed

Approved for use through 05/31/2024. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number			
	Filing Date		2024-03-18	
	First Named Inventor	Lilan ZHANG		
	Art Unit	TBD		
	Examiner Name	TBD		
	Attorney Docket Number	14850267COA		

U.S.PATENTS							Remove	
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear		
/K.O.A/	1	9812739	B2	2017-11-07	KEFEI			
If you wish to add additional U.S. Patent citation information please click the Add button.							Add	
U.S.PATENT APPLICATION PUBLICATIONS							Remove	
Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear		
/K.O.A/	1	20060147803	A1	2006-07-06	KIM et al.			
/K.O.A/	2	20060035144	A1	2006-02-16	SHIMIZU et al.			
If you wish to add additional U.S. Published Application citation information please click the Add button.							Add	
FOREIGN PATENT DOCUMENTS							Remove	
Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ²	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T ⁵
/K.O.A/	1	2019207755	JP	A	2019-12-05	Maxell Holdings LTD.		☐
/K.O.A/	2	111342129	CN	B	2021-07-20	NINGDE AMPEREX TECHNOLOGY LTD.		☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number			
	Filing Date		2024-03-18	
	First Named Inventor	Lilan ZHANG		
	Art Unit	TBD		
	Examiner Name	TBD		
	Attorney Docket Number	14850267COA		

/K.O.A/	3	110739487	CN	A	2020-01-31	DONGGUAN VEKEN BATTERY CO., LTD.		☐
/K.O.A/	4	109361018	CN	A	2019-02-19	NINGDE AMPEREX TECHNOLOGY LTD.		☐
/K.O.A/	5	110042439	CN	A	2019-07-23	FUJIAN QINGJING COPPER FOIL CO., LTD.		☐
/K.O.A/	6	102668221	CN	A	2012-09-12	NEC ENERGY DEVICES LTD.		☐
/K.O.A/	7	107251309	CN	A	2017-10-13	SAMSUNG SDI CO., LTD.		☐
/K.O.A/	8	2018156803	JP	A	2018-10-04	ASAHI KASEI CORP.		☐
/K.O.A/	9	107256980	CN	A	2017-10-17	HARBIN INSTITUTE OF TECHNOLOGY		☐
/K.O.A/	10	102171869	CN	A	2011-08-11	EQUOS RES. K.K.		☐
/K.O.A/	11	104505535	CN	A	2015-04-08	ZHUHAI SMOOTHWAY ELECTRONIC MAT CO., LTD.		☐
/K.O.A/	12	105057354	CN	A	2015-11-18	FULLWAY TECHNOLOGY WUJIANG CO., LTD.		☐
If you wish to add additional Foreign Patent Document citation information please click the Add button								Add
NON-PATENT LITERATURE DOCUMENTS								Remove

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		2024-03-18
	First Named Inventor	Lilan ZHANG	
	Art Unit	TBD	
	Examiner Name	TBD	
Attorney Docket Number		14850267COA	

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
/K.O.A/	1	European Extended Search Report mailed April 24, 2023 in European counterpart application EP20923314.7, 10 pages in English	☐
/K.O.A/	2	Chinese First Office Action mailed May 25, 2022 in counterpart Chinese application CN202110727536.3, 8 pages in Chinese	☐
/K.O.A/	3	Chinese First Office Action mailed February 19, 2021 in counterpart Chinese application CN202010140217.8, 9 pages in Chinese	☐
/K.O.A/	4	PCT International Search Report mailed November 25, 2020 in PCT counterpart application PCT/CN2020/077638, 4 pages in Chinese	☐

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature	/KARIE O'NEILL APICELLA/	Date Considered	09/23/2024
--------------------	--------------------------	-----------------	------------

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		2024-03-18
	First Named Inventor	Lilan ZHANG	
	Art Unit	TBD	
	Examiner Name	TBD	
	Attorney Docket Number	14850267COA	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Timothy J. Maier/	Date (YYYY-MM-DD)	2024-03-18
Name/Print	Timothy J. Maier	Registration Number	51986

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	3	("20060035144" OR "20060147803" OR "9812739").pn.	(US-PGPUB; USPAT)	ADJ	ON	ON	2024/09/23 10:05 AM
L2	3118	H01M\$.cpc. AND battery AND (electrolyte WITH nitrile)	(US-PGPUB; USPAT)	ADJ	ON	ON	2024/09/23 10:07 AM
L3	17599	H01M\$.cpc. AND battery AND (electrolyte WITH nitrile)	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2024/09/23 10:07 AM
L4	8661	H01M\$.cpc. AND battery AND (electrolyte WITH nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper)))	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2024/09/23 10:07 AM
L5	709	H01M\$.cpc. AND battery AND (electrolyte WITH nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper))) AND ((current collector) WITH tab)	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2024/09/23 10:08 AM
L6	568	H01M10/0525,0567,0569.cpc. AND battery AND (electrolyte WITH	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH,	ADJ	ON	ON	2024/09/23 10:09 AM

09/23/2024 11:15:04 AM
Workspace: 18607737 Zhang

Page 1 of 3
KA

L7	28	nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper))) AND ((current collector) WITH tab)	CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2024/09/23 10:09 AM
L8	26999	H01M10/0525,0567,0569.cpc. AND battery AND (electrolyte WITH nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper))) AND ((current collector) WITH tab) AND ((current collector) WITH (coated AND uncoated))	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2024/09/23 10:09 AM
L9	1524	ningde.as,aanm. AND battery AND electrolyte AND nitrile	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2024/09/23 10:10 AM
L10	820	ningde.as,aanm. AND battery AND (electrolyte WITH nitrile)	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH,	ADJ	ON	ON	2024/09/23 10:10 AM

			CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))				
--	--	--	--	--	--	--	--

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/607,737	03/18/2024	Lilan ZHANG	14850267COA	7065
62008	7590	09/24/2024		
MAIER & MAIER, PLLC 345 SOUTH PATRICK STREET ALEXANDRIA, VA 22314			EXAMINER APICELLA, KARIE O	
			ART UNIT	PAPER NUMBER
			1725	
			NOTIFICATION DATE	DELIVERY MODE
			09/24/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docket@maierandmaier.com
maierandmaier_PAIR@firsttofile.com

Office Action Summary

Application No.

18/607,737

Applicant(s)

ZHANG et al.

Examiner

KARIE O APICELLA

Art Unit

1725

AIA (FITF) Status

Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on 18 March 2024.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on ____.

2a) ☐ This action is **FINAL**.

2b) ☒ This action is non-final.

3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on ____; the restriction requirement and election have been incorporated into this action.

4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☒ Claim(s) 1-19 is/are pending in the application.

5a) Of the above claim(s) ____ is/are withdrawn from consideration.

6) ☐ Claim(s) ____ is/are allowed.

7) ☒ Claim(s) 1-19 is/are rejected.

8) ☐ Claim(s) ____ is/are objected to.

9) ☐ Claim(s) ____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10) ☐ The specification is objected to by the Examiner.

11) ☒ The drawing(s) filed on 18 March 2024 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☐ All b) ☐ Some** c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. ____.

3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

3) ☐ Interview Summary (PTO-413)

Paper No(s)/Mail Date ____.

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)

4) ☐ Other: ____.

Paper No(s)/Mail Date 03-18-24.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.
2. Claims 1-19 are pending in this office action.

Priority

3. Applicant's claim for the benefit of a prior-filed application under 35 U.S.C. 119(e) or under 35 U.S.C. 120, 121, or 365(c) is acknowledged.

Information Disclosure Statement

4. Information disclosure statement (IDS), submitted March 18, 2024, has been received and considered by the examiner.

Claim Rejections - 35 USC § 103

5. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis (i.e., changing from AIA to pre-AIA) for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.
6. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the

claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

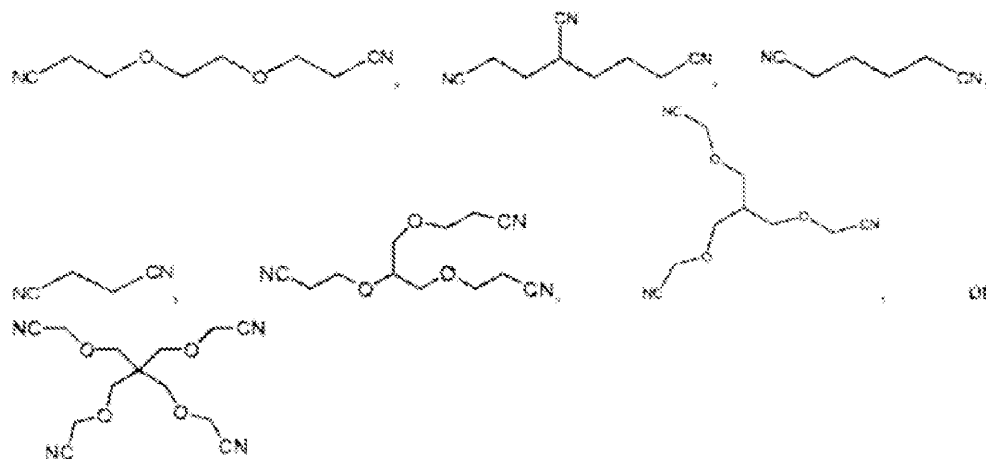
7. The factual inquiries for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating

obviousness or nonobviousness.

8. Claims 1-2 and 14-16 are rejected under 35 U.S.C. 103 as being unpatentable over Kim et al. (US 2006/0147803 A1).

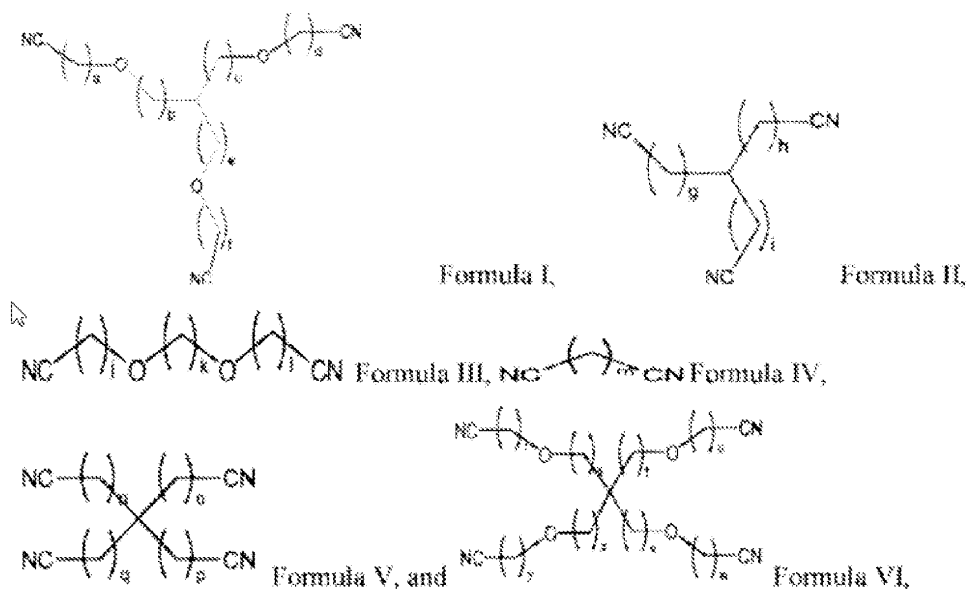
With regard to Claim 1, Kim et al. disclose an electrochemical device, comprising: a positive electrode, a negative electrode, a separator and an electrolyte; wherein the electrolyte comprises a nitrile compound, wherein the nitrile compound comprises at least succinonitrile, glutaronitrile, and adiponitrile (paragraph 0016), which meets the claimed limitation of:



and a mass percentage of the nitrile compound in the electrolyte is A%, or 0.1 wt% to 10 wt% (paragraph 0018); the negative electrode comprises a current collector, wherein the current collector comprises a first region and a second region (every current collector has a first region that is coated with at least an active material and a second region that is at least a small area that is uncoated and connected to a tab), a negative electrode active substance layer is provided only in the first region (paragraphs 0007-0028). Kim et al. do not specifically disclose an area of the second region is B% of the surface area of the current collector; and $A \times B < 600$. Before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to manufacture the current collector to have an area of the second region as B% of the surface area of the current collector; and $A \times B < 600$, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.

With regard to Claim 2, Kim et al. disclose wherein the nitrile compound comprises at least succinonitrile, glutaronitrile, and adiponitrile (paragraph 0016), which

meets the claimed limitation of comprising at least one of a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V, or a compound of Formula VI:

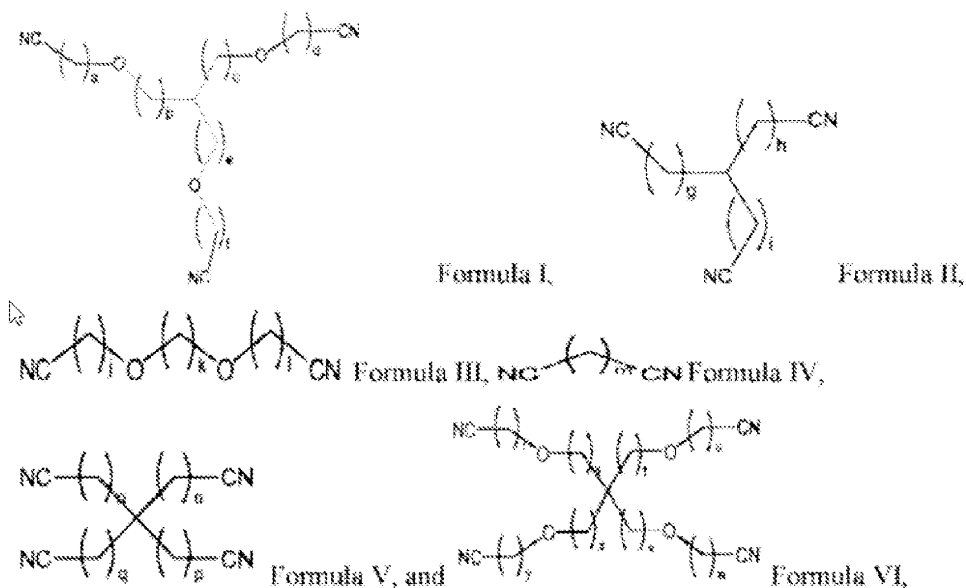


wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, l, n, o, p, q, s, t, v and x is an integer independently selected from 0 to 5; and the mass percentage of A% of the nitrile compound in the electrolyte is 0.1 wt% to 10 wt % (paragraph 0018).

With regard to Claim 14, Kim et al. disclose an electronic device, comprising an electrochemical device (paragraphs 0003, 0008), wherein the electrochemical device comprises a positive electrode, a negative electrode, a separator and an electrolyte; wherein the electrolyte comprises a nitrile compound, and a mass percentage of the nitrile compound in the electrolyte is A%, or 0.1 wt% to 10 wt% (paragraph 0018); the negative electrode comprises a current collector, wherein the current collector

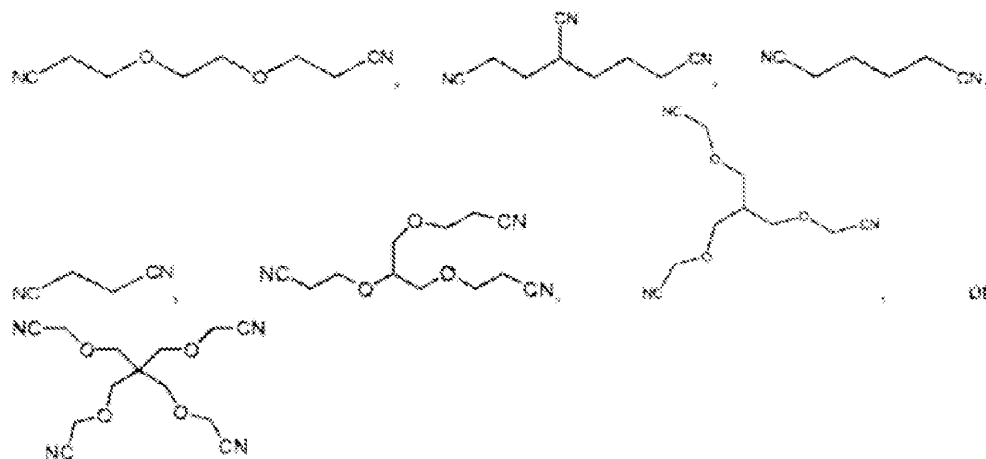
comprises a first region and a second region (every current collector has a first region that is coated with at least an active material and a second region that is at least a small area that is uncoated and connected to a tab), a negative electrode active substance layer is provided only in the first region (paragraphs 0007-0028). Kim et al. do not specifically disclose an area of the second region is B% of the surface area of the current collector; and $A \times B < 600$. Before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to manufacture the current collector to have an area of the second region as B% of the surface area of the current collector; and $A \times B < 600$, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.

With regard to Claim 15, Kim et al. disclose wherein the nitrile compound comprises at least succinonitrile, glutaronitrile, and adiponitrile (paragraph 0016), which meets the claimed limitation of comprising at least one of a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V, or a compound of Formula VI:



wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, l, n, o, p, q, s, t, v and x is an integer independently selected from 0 to 5; and the mass percentage of A% of the nitrile compound in the electrolyte is 0.1 wt% to 10 wt % (paragraph 0018).

With regard to Claim 16, Kim et al. disclose wherein the nitrile compound comprises at least succinonitrile, glutaronitrile, and adiponitrile (paragraph 0016), which meets the claimed limitation of:



9. Claims 3-13 and 17-19 are rejected under 35 U.S.C. 103 as being unpatentable over Kim et al. (US 2006/0147803 A1), as applied to Claims 1-2 and 14-16 above, and in further view of Kefei (US 9,812,739).

With regard to Claims 3 and 8, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein the negative electrode comprises at least one tab, the tab is formed by being connected to the second region through welding, and $A \times B < 210$; and wherein the current collector is a copper foil and the copper foil has one or more of the following properties: a copper purity of $\geq 99.5\%$, a thickness of 3 microns to 15 microns, a weight per unit area of 30 g/m^2 to 150 g/m^2 , a tensile strength of $\geq 220 \text{ kg/mm}^2$, and an elongation rate of $\geq 1.5\%$.

Kefei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Kefei discloses wherein the lithium-ion battery includes a negative electrode having a negative electrode active material evenly spread on to a negative

electrode current collector of copper foil and electrode tabs welded on to the current collector to obtain a negative electrode film, the copper foil having a thickness of 12 μm (column 6, line 61 through column 7, line 11). Before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to include a negative electrode comprising at least one tab, the tab is formed by being connected to the second region through welding, and wherein the current collector is a copper foil and the copper foil has one or more of the following properties: a copper purity of $\geq 99.5\%$, a thickness of 3 microns to 15 microns, a weight per unit area of 30 g/m^2 to 150 g/m^2 , a tensile strength of $\geq 220 \text{ kg/mm}^2$, and an elongation rate of $\geq 1.5\%$, because Kefei teaches that this configuration allows for the battery to work normally for a long period at high voltage, maintain excellent high-temperature storage performance, cycle performance, and C-rate performance (column 5, lines 22-25).

Kefei does not specifically disclose $A \times B < 210$, however, before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to include a negative electrode comprising at least one tab, and $A \times B < 210$, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.

With regard to Claim 4, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein the negative electrode comprises at least one tab, the tab is formed by cutting the current collector, the tab

comprises a region not coated with the negative electrode active substance layer, and $A \times B < 500$.

Keifei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Keifei discloses wherein the lithium-ion battery includes a negative electrode having a negative electrode active material evenly spread on to a negative electrode current collector of copper foil and electrode tabs welded on to the current collector to obtain a negative electrode film (the area of welding being an uncoated region of the current collector) (column 6, line 61 through column 7, line 11). Before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to include a negative electrode comprising at least one tab, the tab comprising a region not coated with the negative electrode active substance layer, because Keifei teaches that this configuration allows for the battery to work normally for a long period at high voltage, maintain excellent high-temperature storage performance, cycle performance, and C-rate performance (column 5, lines 22-25).

Keifei does not specifically disclose $A \times B < 500$, however, before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to include a negative electrode comprising at least one tab, and $A \times B < 500$, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.

With regard to Claim 5, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to an edge of the current collector and the edge of the current collector is C , and $0 \leq C/\text{tab width} \leq 50$.

Kefei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Kefei discloses wherein the lithium-ion battery includes a negative electrode having a negative electrode active material evenly spread on to a negative electrode current collector of copper foil and electrode tabs welded on to the current collector to obtain a negative electrode film (the area of welding being an uncoated region of the current collector) (column 6, line 61 through column 7, line 11).

Kefei does not specifically disclose wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to an edge of the current collector and the edge of the current collector is C , and $0 \leq C/\text{tab width} \leq 50$, however, before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to an edge of the current collector and the edge of the current collector is C , and $0 \leq C/\text{tab width} \leq 50$, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05; and

since it has been held in the art that rearranging parts of an invention involves only routine skill in the art. See MPEP 2144.04 (VI).

With regard to Claim 6, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to an edge of the current collector and the edge of the current collector is C , and $0 \leq C/\text{tab width} \leq 50$.

Kefei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Kefei discloses wherein the lithium-ion battery includes a negative electrode having a negative electrode active material evenly spread on to a negative electrode current collector of copper foil and electrode tabs welded on to the current collector to obtain a negative electrode film (the area of welding being an uncoated region of the current collector) (column 6, line 61 through column 7, line 11).

Kefei does not specifically disclose wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to an edge of the current collector and the edge of the current collector is C , and $0 \leq C/\text{tab width} \leq 50$, however, before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to an edge of the current collector and the edge of the current collector is C , and $0 \leq C/\text{tab width} \leq 50$, since it has been held that discovering an optimum value of

a result effective variable involves only routine skill in the art. See MPEP 2144.05; and since it has been held in the art that rearranging parts of an invention involves only routine skill in the art. See MPEP 2144.04 (VI).

With regard to Claim 7, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein at least one of the second region is positioned at an edge of the current collector, and an edge of the second region positioned at the edge of the current collector is either folded or not folded, wherein when the edge of the second region positioned at the edge of the current collector is folded, a width of the folded region is D, and $0.1 \leq D/\text{tab width} \leq 20$.

Kefei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Kefei discloses wherein the lithium-ion battery includes a negative electrode having a negative electrode active material evenly spread on to a negative electrode current collector of copper foil and electrode tabs welded on to the current collector to obtain a negative electrode film (the area of welding being an uncoated region of the current collector) (column 6, line 61 through column 7, line 11).

Kefei does not specifically disclose wherein at least one of the second region is positioned at an edge of the current collector, and an edge of the second region positioned at the edge of the current collector is either folded or not folded, wherein when the edge of the second region positioned at the edge of the current collector is folded, a width of the folded region is D, and $0.1 \leq D/\text{tab width} \leq 20$, however, before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to at least one of the second

region is positioned at an edge of the current collector, wherein when the edge of the second region positioned at the edge of the current collector is folded, a width of the folded region is D , and $0.1 \leq D/\text{tab width} \leq 20$, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05; and since it has been held in the art that rearranging parts of an invention involves only routine skill in the art. See MPEP 2144.04 (VI).

The recitation, “an edge of the second region positioned at the edge of the current collector is either folded or not folded”, is considered a product-by-process limitation. Product-by-process claims are not limited to the manipulations of the recited steps, only the structure implied by the steps. “Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process.” *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985).

The recitation, “wherein when the edge of the second region positioned at the edge of the current collector is folded, a width of the folded region is D , and $0.1 \leq D/\text{tab width} \leq 20$, is considered a contingent limitation. A contingent limitation requires only those limitations that must be performed and does not include limitations or given patentable weight to limitations that are not required to be performed because the condition(s) precedent are not met. See MPEP 2111.04.

With regard to Claims 9-11, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein the second region is covered by a substance adhered onto the second region; and, wherein a position of at least the one tab is covered by a substance bonded onto the position of the tab.

Kefei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Kefei discloses wherein the lithium-ion battery includes a negative electrode having a negative electrode active material evenly spread on to a negative electrode current collector of copper foil and electrode tabs welded on to the current collector to obtain a negative electrode film (the area of welding being an uncoated region of the current collector) (column 6, line 61 through column 7, line 11). Therefore, Kefei discloses wherein the second region (the uncoated region) is covered by a substance (welding material) adhered to the second region; and, wherein a position of the at least one tab (the uncoated region) is covered by a substance (welding material) bonded onto the position of the tab (at the uncoated region). Before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to include the second region being covered by a substance adhered onto the second region; and, wherein a position of at least the one tab is covered by a substance bonded onto the position of the tab, because Kefei teaches that this configuration allows for the battery to work normally for a long period at high voltage, maintain excellent high-temperature storage performance, cycle performance, and C-rate performance (column 5, lines 22-25).

With regard to Claims 12-13, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein the electrolyte further comprises an additive, and the additive comprises at least one of the following: 1,3-propane sultone, fluoroethylene carbonate, vinylene carbonate, 2,4-butane sultone, 1,4-butane sultone, methylene methanedisulfonate, ethylene sulfate, succinic anhydride, ethoxy (pentafluoro)cyclotriphosphazene, 1,3-dioxane, or propenyl-1,3-sultone; and wherein the electrolyte further comprises an anion, the anion comprises at least one of Cl^- , Br^- , SO_4^{2-} , CO_3^{2-} or F^- , and the content of the anion in the electrolyte is less than or equal to 1000 ppm.

Kefei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Kefei discloses wherein the electrolyte comprises at least 1,3-propane sultone, vinylene carbonate, 1,4-butane sultone, and ,methylene methanedisulfonate, as well as, an anion of at least one of SO_4^{2-} , CO_3^{2-} or F^- (column 3, line 1 through column 4, line 32). Before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to include the electrolyte further comprising an additive, and the additive comprising at least one of the following: 1,3-propane sultone, fluoroethylene carbonate, vinylene carbonate, 2,4-butane sultone, 1,4-butane sultone, methylene methanedisulfonate, ethylene sulfate, succinic anhydride, ethoxy (pentafluoro)cyclotriphosphazene, 1,3-dioxane, or propenyl-1,3-sultone; and wherein the electrolyte further comprises an anion, the anion comprises at least one of Cl^- , Br^- , SO_4^{2-} , CO_3^{2-} or F^- , because Kefei teaches that these materials allow for the battery to

maintain a good cycle life, low temperature discharge characteristics, and high temperature storage characteristics even at high voltage (column 1, lines 59-64).

Kefei does not specifically disclose wherein the content of anion in the electrolyte is less than or equal to 1000 ppm. However, before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to include the content of anion in the electrolyte to be less than or equal to 1000 ppm, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.

With regard to Claim 17, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein the negative electrode comprises at least one tab, the tab is formed by being connected to the second region through welding, and $A \times B < 210$.

Kefei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Kefei discloses wherein the lithium-ion battery includes a negative electrode having a negative electrode active material evenly spread on to a negative electrode current collector of copper foil and electrode tabs welded on to the current collector to obtain a negative electrode film, the copper foil having a thickness of 12 μm (column 6, line 61 through column 7, line 11). Kefei does not specifically disclose $A \times B < 210$, however, before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to include a negative electrode comprising at least one tab, and $A \times B < 210$, since it

has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.

With regard to Claim 18, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein the negative electrode comprises at least one tab, the tab is formed by cutting the current collector, the tab comprises a region not coated with the negative electrode active substance layer, and $A \times B < 500$.

Kefei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Kefei discloses wherein the lithium-ion battery includes a negative electrode having a negative electrode active material evenly spread on to a negative electrode current collector of copper foil and electrode tabs welded on to the current collector to obtain a negative electrode film (the area of welding being an uncoated region of the current collector) (column 6, line 61 through column 7, line 11). Before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to include a negative electrode comprising at least one tab, the tab comprising a region not coated with the negative electrode active substance layer, because Kefei teaches that this configuration allows for the battery to work normally for a long period at high voltage, maintain excellent high-temperature storage performance, cycle performance, and C-rate performance (column 5, lines 22-25).

Kefei does not specifically disclose $A \times B < 500$, however, before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to

modify the electrochemical device of Kim et al. to include a negative electrode comprising at least one tab, and $A \times B < 500$, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.

With regard to Claim 19, Kim et al. disclose the electrochemical device in paragraph 8 above, but do not specifically disclose wherein the second region is covered by a substance adhered onto the second region.

Kefei discloses a lithium-ion battery comprising an electrolyte solution including an additive of a multi-nitrile compound and a sulfur-oxygen double-bond containing compound (Abstract). Kefei discloses wherein the lithium-ion battery includes a negative electrode having a negative electrode active material evenly spread on to a negative electrode current collector of copper foil and electrode tabs welded on to the current collector to obtain a negative electrode film (the area of welding being an uncoated region of the current collector) (column 6, line 61 through column 7, line 11). Therefore, Kefei discloses wherein the second region (the uncoated region) is covered by a substance (welding material) adhered to the second region. Before the effective filing date of the invention it would have been obvious to one of ordinary skill in the art to modify the electrochemical device of Kim et al. to include the second region being covered by a substance adhered onto the second region, because Kefei teaches that this configuration allows for the battery to work normally for a long period at high voltage, maintain excellent high-temperature storage performance, cycle performance, and C-rate performance (column 5, lines 22-25).

Conclusion

1. Any inquiry concerning this communication or earlier communications from the examiner should be directed to KARIE O APICELLA whose telephone number is (571)272-8614. The examiner can normally be reached Monday thru Friday; 8:00AM to 5:00PM EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Basia Ridley can be reached on 571-272-1453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: <https://patentcenter.uspto.gov>. Visit <https://www.uspto.gov/patents/apply/patent-center> for more information about Patent Center and <https://www.uspto.gov/patents/docx> for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/KARIE O'NEILL APICELLA/
Primary Examiner, Art Unit 1725

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

<i>In re</i> Patent Application of: Ningde Ampere Technology Limited	Confirmation No.: 7065
U.S. Patent Application No. 18/607,737	Art Unit: 1725
Filed: March 18, 2024	Examiner: KARIE O APICELLA
Title: ELECTROLYTE AND ELECTROCHEMICAL DEVICE	Attorney Docket No.: 14850267COA

AMENDMENT AND RESPONSE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

December 24, 2024

Dear Commissioner:

In response to the Office Action mailed September 24, 2024, Applicant respectfully requests reconsideration of the Application in view of the following Amendments and Remarks.

Amendments to the Claims begin on page 2.

Remarks follow the above-mentioned amendments.

AMENDMENTS TO THE CLAIMS/CLAIM LIST

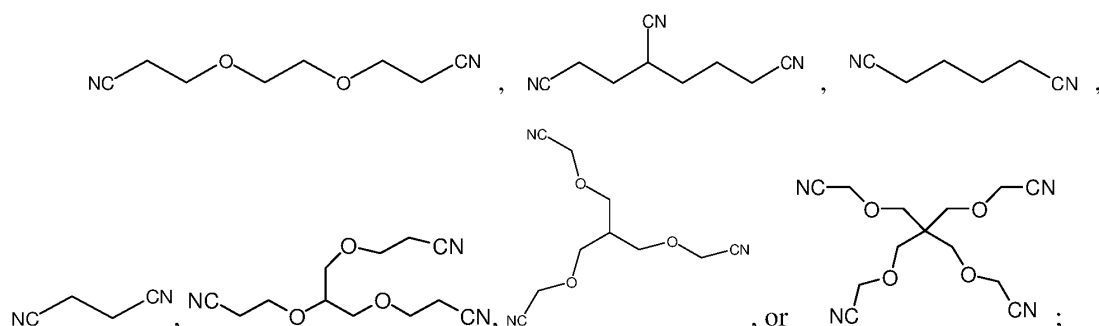
Please **AMEND** claims 1, 2, 14, and 15 as shown below.

The following list of claims replaces any prior listing of claims:

1. (Currently Amended) An electrochemical device, comprising: a positive electrode, a negative electrode, a separator, and an electrolyte; wherein

the electrolyte comprises a nitrile compound, wherein

the nitrile compound comprises at least one of:



and a mass percentage of the nitrile compound in the electrolyte ~~A%~~, A%, is 0.1% to 10%;

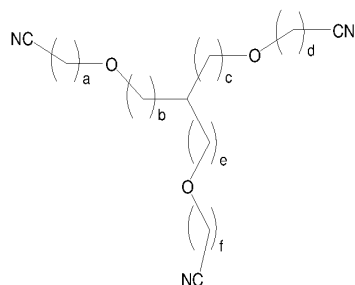
the negative electrode comprises a current collector, wherein the current collector comprises a first region and a second region;

a negative electrode active substance layer is provided only in the first region;

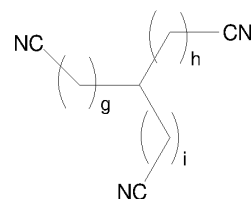
an area of the second region, ~~is B%~~, is 0.4% to 54% of ~~the~~ a surface area of the current collector; and

$A \times B < 600$.

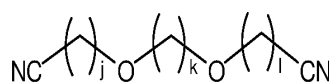
2. (Currently Amended) The electrochemical device according to claim 1, wherein the nitrile compound comprises at least one of a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V or a compound of Formula VI:



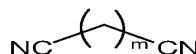
Formula I,



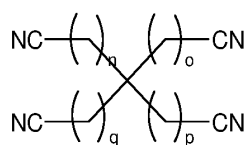
Formula II,



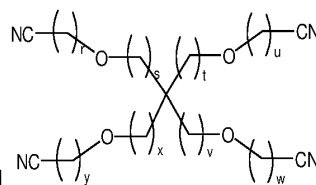
Formula III,



Formula IV,



Formula V, and



Formula VI,

wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is an integer independently selected from 0 to 5; and the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%.

3. (Original) The electrochemical device according to claim 1, wherein the negative electrode comprises at least one tab, the tab is formed by being connected to the second region through welding, and $A \times B < 210$.

4. (Original) The electrochemical device according to claim 1, wherein the negative electrode comprises at least one tab, the tab is formed by cutting the current collector, the tab comprises a region not coated with the negative electrode active substance layer, and $A \times B < 500$.

5. (Original) The electrochemical device according to claim 3, wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to an edge of the current collector and the edge of the current collector is C, and $0 \leq C/\text{tab width} \leq 50$.

6. (Original) The electrochemical device according to claim 4, wherein at least one of the second region is positioned at an edge of the current collector, wherein a distance between a first tab from the at least one tab closest to the edge of the current collector and the edge of the current collector is C, and $0 \leq C/\text{tab width} \leq 50$.

7. (Original) The electrochemical device according to claim 1, wherein at least one of the second region is positioned at the edge of the current collector, and an edge of the second region positioned at the edge of the current collector is either folded or not folded, wherein when the edge of the second region positioned at the edge of the current collector is folded, a width of the folded region is D, and $0.1 \leq D/\text{tab width} \leq 20$.

8. (Original) The electrochemical device according to claim 1, wherein the current collector is a copper foil and the copper foil has one or more of the following properties:
a copper purity of $\geq 99.5\%$,

a thickness of 3 microns to 15 microns,
a weight per unit area of 30 g/m² to 150 g/m²,
a tensile strength of ≥ 20 kg/mm², and
an elongation rate of $\geq 1.5\%$.

9. (Original) The electrochemical device according to claim 1, wherein the second region is covered by a substance adhered onto the second region.

10. (Original) The electrochemical device according to claim 3, wherein a position of the at least one tab is covered by a substance bond onto the position of the tab.

11. (Original) The electrochemical device according to claim 4, wherein a position of the at least one tab is covered by a substance bond onto the position of the tab.

12. (Original) The electrochemical device according to claim 1, wherein the electrolyte further comprises an additive, and the additive comprises at least one of the following: 1,3-propane sultone, fluoroethylene carbonate, vinylene carbonate, 2,4-butane sultone, 1,4-butane sultone, methylene methanedisulfonate, ethylene sulfate, succinic anhydride, ethoxy(pentafluoro)cyclotriphosphazene, 1,3-dioxane, or propenyl-1,3-sultone.

13. (Original) The electrochemical device according to claim 1, wherein the electrolyte further comprises an anion, the anion comprises at least one of Cl⁻, Br⁻, SO₄²⁻, CO₃²⁻ or F⁻, and the content of the anion in the electrolyte is less than or equal to 1000 ppm.

14. (Currently Amended) An electronic device, comprising an electrochemical device, wherein the electrochemical device comprises a positive electrode, a negative electrode, a separator,

and an electrolyte; wherein

the electrolyte comprises a nitrile compound, and a mass percentage of the nitrile compound in the electrolyte ~~is~~, A%, is 0.1% to 10%;

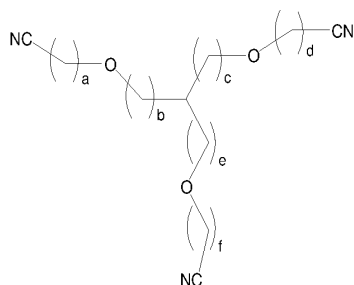
the negative electrode comprises a current collector, wherein the current collector comprises a first region and a second region;

a negative electrode active substance layer is provided only in the first region;

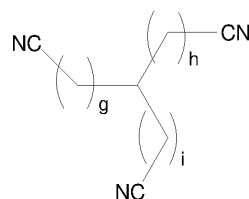
an area of the second region, ~~is~~ B%, is 0.4% to 54% of the a surface area of the current collector; and

$A \times B < 600$.

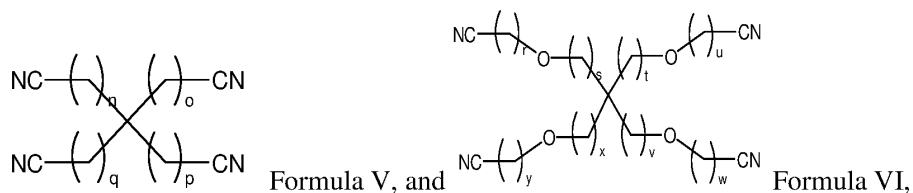
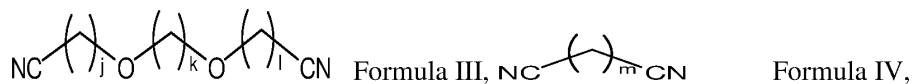
15. (Currently Amended) The electronic device according to claim 14, wherein the nitrile compound comprises at least one of a compound of Formula I, a compound of Formula II, a compound of Formula III, a compound of Formula IV, a compound of Formula V or a compound of Formula VI:



Formula I,

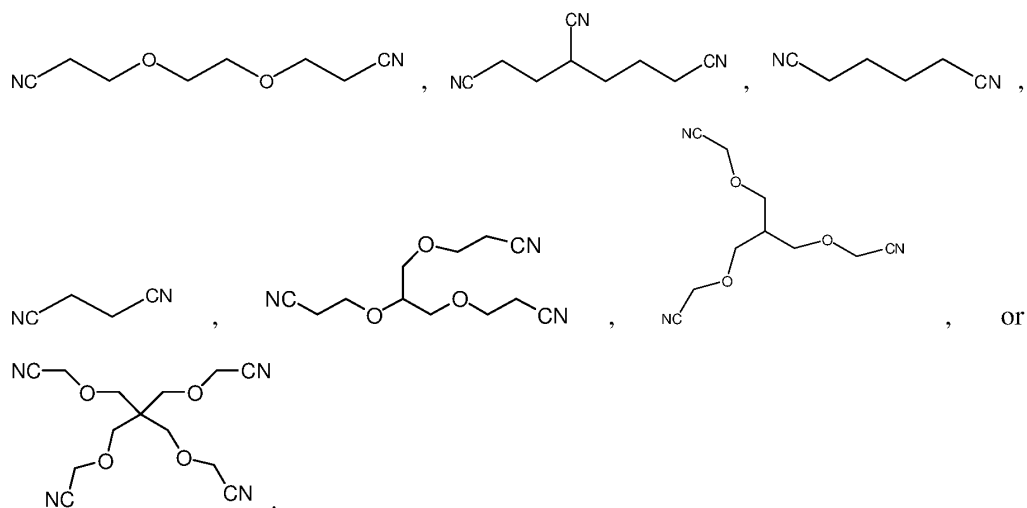


Formula II,



wherein each of a, d, f, j, k, l, m, r, u, w and y is an integer independently selected from 1 to 5, and each of b, c, e, g, h, i, n, o, p, q, s, t, v and x is an integer independently selected from 0 to 5; and the mass percentage A% of the nitrile compound in the electrolyte is 0.1% to 10%.

16. (Original) The electrochemical device according to claim 14, wherein the nitrile compound comprises at least one of:



17. (Original) The electrochemical device according to claim 14, wherein the negative electrode comprises a tab, the tab is formed by being connected to the second region through welding, and $A \times B < 210$.

18. (Original) The electrochemical device according to claim 14, wherein the negative electrode comprises at least one tab, the tab is formed by cutting the current collector, the tab comprises a region not coated with the negative electrode active substance layer, and $A \times B < 500$.

19. (Original) The electrochemical device according to claim 14, wherein the second region is covered by a substance adhered onto the second region.

REMARKS

Favorable reconsideration of this Application, in light of the following discussion, is respectfully requested. Claims 1-19 were originally presented. Claims 1, 2, 14, and 15 have been amended, and no new claims have been added. Accordingly, claims 1-19 are pending in the present Application. Applicant submits that upon entry of the present Response, claims 1-19 are in condition for allowance. Moreover, the Applicant submits that no new matter has been introduced by the foregoing amendments.

Rejections under 35 U.S.C. §103

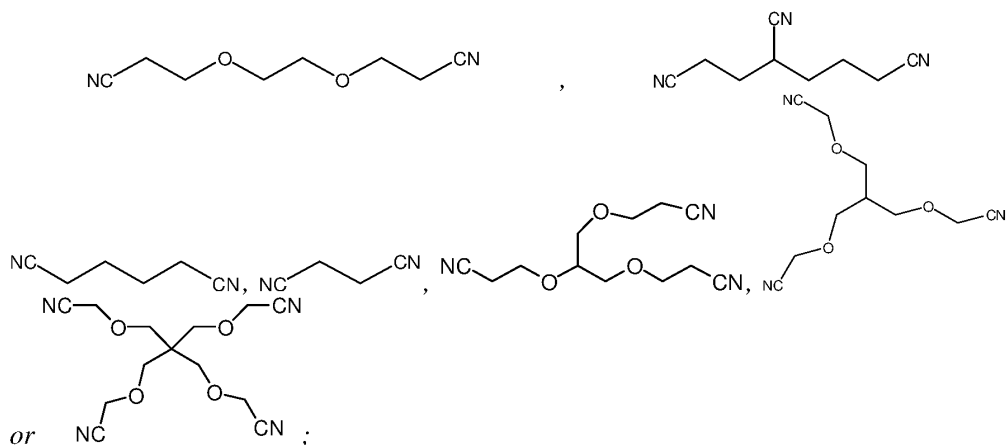
In the outstanding Office Action, claims 1, 2, and 14-16 stand rejected under 35 U.S.C. § 103 as unpatentable over U.S. Patent Application Publication No. 2006/0147803, applied for by Kim, et al. (“Kim”).

In the outstanding Office Action, claims 3-13 and 17-19 stand rejected under 35 U.S.C. § 103 as unpatentable over Kim as applied to claims 1-2 and 14-16 and further in view of U.S. Patent No. 9,812,739, issued to Kefei (“Kefei”).

Addressing now the rejection of claims 1-19 under 35 U.S.C. § 103 as unpatentable over Kim in view of Kefei, this rejection is respectfully traversed. Independent claims 1 and 14 have been amended to overcome the rejection under 35 U.S.C. § 103 by specifying that “a mass percentage of the nitrile compound in the electrolyte, A%, is 0.1% to 10%” and “an area of the second region, B%, is 0.4% to 54% of the surface area of the current collector”. Support for this amendment may be found, for example, in claims 2 and 15, paragraph [0046], Example 52 in Table 2, and Example 56 in Table 3 of the present published specification. Accordingly, claims 2 and 15 have been amended to remove the duplicate limitation.

Claim 1 now recites:

An electrochemical device, comprising: a positive electrode, a negative electrode, a separator and an electrolyte; wherein the electrolyte comprises a nitrile compound, wherein the nitrile compound comprises at least one of:



and a mass percentage of the nitrile compound in the electrolyte, A%, is 0.1% to 10%;
the negative electrode comprises a current collector, wherein the current collector comprises a first region and a second region;
a negative electrode active substance layer is provided only in the first region;
an area of the second region, B%, is 0.4% to 54% of the surface area of the current collector; and
 $A \times B < 600$.

Claim 14 now recites:

An electronic device, comprising an electrochemical device, wherein the electrochemical device comprises a positive electrode, a negative electrode, a separator and an electrolyte; wherein
the electrolyte comprises a nitrile compound, and a mass percentage of the nitrile compound in the electrolyte, A%, is 0.1% to 10%;
the negative electrode comprises a current collector, wherein the current collector comprises a first region and a second region;
a negative electrode active substance layer is provided only in the first region;
an area of the second region B%, is 0.4% to 54% of the surface area of the current collector; and
 $A \times B < 600$.

Kim, however, fails to teach or suggest Applicant's claimed electrochemical device (claims 1-13) and the claimed electronic device (claims 14-19). In particular, and as acknowledged by the outstanding Office Action,¹ “Kim et al. do not specifically disclose an area of the second region is B% of the surface area of the current collector; and $A \times B < 600$ ”. Specifically, Kim fails to teach the following features:

¹ See outstanding Office Action at page 4, lines 8-9.

- **Independent Claims 1 and 14:** *a negative electrode active substance layer is provided only in the first region; an area of the second region, B%, is 0.4% to 54% of the surface area of the current collector; and $A \times B < 600$ (where A% is a mass percentage of the nitrile compound in the electrolyte, 0.1% to 10%)*

The outstanding Office Action asserts that it would be obvious “to manufacture the current collector to have an area of the second region as B% of the surface area of the current collector; and $A \times B < 600$, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.”² However, Applicant respectfully disagrees for the following reasons.

First, per MPEP 2144.05 II., while routine optimization may render an invention obvious, this rationale must be supported by factual findings and detailed reasoning. Specifically, the MPEP states, “In order to properly support a rejection on the basis that an invention is the result of ‘routine optimization’, the examiner must make findings of relevant facts, and present the underpinning reasoning in sufficient detail. The *articulated rationale must include an explanation of why it would have been routine optimization to arrive at the claimed invention and why a person of ordinary skill in the art would have had a reasonable expectation of success to formulate the claimed range.*” (Emphasis added.) Indeed, MPEP 2144.05 II.B. states, “A particular parameter must first be recognized as a result-effective variable, i.e., a variable which achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as routine experimentation.” (Citation omitted.)

In the instant case, the rejection does not include this required explanation to establish “routine optimization” is obvious based on Kim. Kim at best teaches coating the copper collector,³ but fails to ever mention that only a portion should be coated. It also fails to provide any guidance regarding the specific claimed features, such as the area of the second region (B%, which is not coated with the negative electrode active substance layer), which is 0.4% to 54% of the surface area of the current collector, or the relationship $A \times B < 600$.

Similarly, Kefei fails to provide guidance on these features. The outstanding Office Action cites Kefei and states that it would be obvious “to modify the electrochemical device of Kim et al.

² See outstanding Office Action at page 6, lines 6-10.

³ See Kim, for example, at paragraph [0017].

to include a negative electrode comprising at least one tab, and $A \times B < 210$, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. See MPEP 2144.05.”⁴ However, Applicant respectfully disagrees.

Kefei does not mention that only a portion of the current collector should be coated. Instead, it simply describes that a negative electrode collector *may* be coated with an anode membrane comprising an anode active material.⁵ Neither Kim nor Kefei provides any guidance regarding the specific claimed features related to the area of the second region (B%, which is not coated with the negative electrode active substance layer), which is 0.4% to 54% of the surface area of the current collector, or the relationship $A \times B < 600$.

Kim and Kefei, therefore, do not provide the motivation to perform the proposed modification of Kim to arrive at the claimed combination of A% (0.1% to 10%) and B% (0.4% to 54%), and their relationship ($A \times B < 600$). While the required evidence of motivation to combine need not come from the applied references themselves, the evidence must come from *somewhere* within the record. In this case, there is nothing in the record supporting the Office Action's proposed modification of Kim.

Furthermore, neither Kim nor Kefei suggests that based on the combination of A% of a nitrile compound as claimed, B% of surface area coating, and the requirement that $A \times B < 600$, one obtains superior properties, such as capacity retention rate, floating charging leakage current, and high temperature storage (so as not expand, i.e., increase the thickness).

The specification clearly demonstrates the criticality of these claimed ranges and relationships, as shown in paragraphs [0119]-[0124]:

- Table 1: Comparative examples 2-7 (A% > 10%) exhibits lower capacity retention rates and higher floating charging leakage current compared to Examples 1-39.
- Table 2: Comparative example 8 (B% > 54%) results in a lower capacity retention rates and higher floating charging leakage current in comparison to the Examples 40-52.
- Table 3: Comparative example 9 (A% > 10% and $A \times B > 600$) shows a higher floating charging leakage current compared to Examples 53-60.

⁴ See outstanding Office Action at page 9, lines 14-19.

⁵ See Kefei, for example, at column 4, lines 54-62.

These results demonstrate that the claimed combination of A% (0.1% to 10%), B% (0.4% to 54%), and their relationship ($A \times B < 600$) are critical for achieving unexpected results, including superior capacity retention, reduced leakage current, and improved stability.

Neither Kim nor Kefei recognized the criticality of these variables or their relationship. Contrary to the Office Action's position, the selection of B% (and the resulting $A \times B < 600$) cannot be characterized as "routine optimization of a result-effective variable." Neither reference recognized that the coating surface percentage B% and the amount nitrile compound A% in the electrolyte, as well as their ratio, as variables that achieve a recognized result, nor do they provide guidance for optimizing these parameters. Thus, the determination of the claimed ranges and relationship ($A \times B < 600$) goes beyond routine experimentation and is not obvious in view of Kim and Kefei.

In rejecting a claim under 35 U.S.C. § 103, the USPTO must support its rejection by "substantial evidence" within the record,⁶ and by "clear and particular" evidence⁷ of a suggestion, teaching, or motivation to combine the teachings of different references. As discussed above, there is no substantial evidence, nor clear and particular evidence, within the record of motivation for modifying Kim to arrive at the claimed invention. Without such motivation and absent improper hindsight reconstruction,⁸ a person of ordinary skill in the art would not be motivated to perform the proposed modification, and Claims 1 and 14 are believed to be non-obvious and patentable over the applied prior art.

As a result, Applicant respectfully submits that independent claims 1 and 14 are patentable over Kim and Kefei. As claims 2-13 depend from independent claim 1, and claims 15-19 depend

⁶ In re Gartside, 203 F3d 1305, 53 USPQ2d 1769 (Fed. Cir. 2000) (holding that, consistent with the Administrative Procedure Act at 5 USC 706(e), the CAFC reviews the Board's decisions based on factfindings, such as 35 U.S.C. § 103(a) rejections, using the 'substantial evidence' standard because these decisions are confined to the factual record compiled by the Board.)

⁷ In re Dembiczak, 175 F3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) ("We have noted that evidence of a suggestion, teaching, or motivation to combine may flow from the prior art references themselves, the knowledge of one of ordinary skill in the art, or, in some cases, from the nature of the problem to be solved, although 'the suggestion more often comes from the teachings of the pertinent references.' The range of sources available, however, does not diminish the requirement for actual evidence. That is, the showing must be clear and particular." (emphasis added).

⁸ See MPEP 2141, stating, as one of the tenets of patent law applying to 35 USC § 103, that "[t]he references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention."

from independent claim 14, Applicant respectfully submits that claims 2-13 and 15-19 are likewise patentable over Kim and Kefei.

Accordingly, for at least the reasons set forth above, Applicant respectfully requests that the §103 rejections of claims 1-19 be withdrawn.

CONCLUSION

Consequently, in view of the present amendment and in light of the above discussion, the outstanding grounds of rejection are believed to have been overcome. The Application, as amended, is believed to be in condition of allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

Maier & Maier, PLLC
345 South Patrick Street
Alexandria, Virginia 22314
(703) 740-8322
Customer No. 62008

/Timothy J. Maier/
Timothy J. Maier
Attorney of Record
Reg. No. 51986

TJM/ps/LC/RAM/kcf

December 24, 2024



UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #
18/607,737

RECEIPT DATE / TIME
12/24/2024 12:36:30 PM Z ET

ATTORNEY DOCKET #
14850267COA

Title of Invention

ELECTROLYTE AND ELECTROCHEMICAL DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	7065	FILED BY	Karina Fernandez
PATENT CENTER #	68508491	FILING DATE	03/18/2024
CUSTOMER #	62008	FIRST NAMED INVENTOR	Lilan ZHANG
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Timothy Maier

Documents

TOTAL DOCUMENTS: 3

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
PAT201908032US2_Response_PDF.pdf	15	-	100 KB
PAT201908032US2_Response_PDF-A....pdf (1-1)	1	Amendment/Request for Reconsideration-After Non- Final Rejection	22 KB
PAT201908032US2_Response_PDF-CLM.pdf (2-8)	7	Claims	54 KB
PAT201908032US2_Response_PDF-REM.pdf (9-15)	7	Applicant Arguments/Remarks Made in an Amendment	59 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
PAT201908032US2_Response _PDF.pdf	7C7A6D95032ADD617786B2A21C614FC6C5012BA26FF0EB3D D33F62FC3319A361AB8F0147FC4A5515FA4046397157ABDA9 A1CD41F5748DBD91E4723E4479D9224
PAT201908032US2_Response _PDF-A....pdf	A9399771CB51FD0CC4A7FC844F8F416E40DB3C2F9C5BC8C3 DD8BB64E7C9ADE62911A80BF06860D7F5C2E9165E93EF1EB 604A3ACB3E6DA4E24B133CC6E1D0637E
PAT201908032US2_Response _PDF-CLM.pdf	F7391FB6D4A55C64249AE6B650FBFC834EBA21B817134E500 87F1534B7D5A5809B2A34D62F12B3EADE1B6D67261A40C0B C9C4A0EF0A2113395210151458C41E1
PAT201908032US2_Response _PDF-REM.pdf	A4EADAFE17E76C6C7F60A2D8573923D02942FF4DBA21A4AA EC4453709E9A3DD37DC3A51025A6537524CBEE46B0DA7B21 5471B6F2B8E2EAC765EEBECBC77ACE03

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 18/607,737	Filing Date 03/18/2024	☐ To be Mailed	
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO							
APPLICATION AS FILED - PART I							
FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	RATE (\$)	FEE (\$)			
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A				
☐ SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A				
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A				
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	x \$100 =				
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	x \$480 =				
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL			
APPLICATION AS AMENDED - PART II							
	(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	12/24/2024	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	* 19	Minus ** 20	= 0	x \$100 =	0	
	Independent (37 CFR 1.16(h))	* 2	Minus *** 3	= 0	x \$480 =	0	
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	0	
	(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	*	Minus **	=	x \$0 =		
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x \$0 =		
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE		
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.					CRU Paralegal		
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".					/RENEE M PRESTON/		
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".							
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.							

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Search Notes 	Application/Control No. 18/607,737	Applicant(s)/Patent Under Reexamination ZHANG et al.
	Examiner KARIE O APICELLA	Art Unit 1725

CPC - Searched*		
Symbol	Date	Examiner
H01M 10/0525, 10/0567, 10/0569	02/26/2025	KOA

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
H01M and text-limited search in PE2E SEARCH	09/23/2024	KOA
Inventor and assignee search in DAV	09/23/2024	KOA
NPL search	09/23/2024	KOA
Updated H01M and text-limited search in PE2E SEARCH	02/26/2025	KOA
Updated inventor and assignee search in DAV and PE2E SEARCH	02/26/2025	KOA
Updated NPL search	02/26/2025	KOA
US Patent and PG-Pub interference search in PE2E SEARCH	02/26/2025	KOA

/KARIE O'NEILL APICELLA/ Primary Examiner, Art Unit 1725	
---	--

<i>Search Notes</i> 	Application/Control No. 18/607,737	Applicant(s)/Patent Under Reexamination ZHANG et al.
	Examiner KARIE O APICELLA	Art Unit 1725

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H01M	10/0525, 10/0567, 10/0569	02/26/2025	KOA

/KARIE O'NEILL APICELLA/ Primary Examiner, Art Unit 1725	
---	--

Issue Classification 	Application/Control No. 18/607,737	Applicant(s)/Patent Under Reexamination ZHANG et al.
	Examiner KARIE O APICELLA	Art Unit 1725

CPC						
Symbol					Type	Version
H01M	/	10	/	0525	F	2013-01-01
H01M	/	10	/	0567	I	2013-01-01
H01M	/	10	/	0569	I	2013-01-01
H01M	/	2300	/	0025	A	2013-01-01

CPC Combination Sets					
Symbol		Type	Set	Ranking	Version
	/		/		

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/KARIE O'NEILL APICELLA/ Primary Examiner, Art Unit 1725	26 February 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20250226

Issue Classification 	Application/Control No. 18/607,737	Applicant(s)/Patent Under Reexamination ZHANG et al.
	Examiner KARIE O APICELLA	Art Unit 1725

INTERNATIONAL CLASSIFICATION			
CLAIMED			
H01M10/0525	/	10	/ 0525
H01M10/0567	/	10	/ 0567
H01M10/0569	/	10	/ 0569
NON-CLAIMED			
/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS
429	217

CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	19	
/KARIE O'NEILL APICELLA/ Primary Examiner, Art Unit 1725	26 February 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20250226

Issue Classification 	Application/Control No. 18/607,737	Applicant(s)/Patent Under Reexamination ZHANG et al.
	Examiner KARIE O APICELLA	Art Unit 1725

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47															
CLAIMS															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE	Total Claims Allowed:	
(Assistant Examiner)	(Date)	19
/KARIE O'NEILL APICELLA/ Primary Examiner, Art Unit 1725	26 February 2025	O.G. Print Claim(s)
(Primary Examiner)	(Date)	1
		O.G. Print Figure
		1

Bibliographic Data

Application No: 18/607,737

Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☒ No ☐ Met After Allowance

Verified and Acknowledged:

/KARIE O'NEILL
APICELLA/

Examiner's Signature

Initials

Title: ELECTROLYTE AND ELECTROCHEMICAL DEVICE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/18/2024	429	1725	14850267COA
RULE			

APPLICANTS

Ningde Amperex Technology Limited, Ningde, Fujian, CHINA

INVENTORS

Lilan ZHANG, Ningde, CHINA
Chao TANG, Ningde, CHINA
Jianming ZHENG, Ningde,

CONTINUING DATA

This application is a CON of 16970864 08/18/2020 PAT 11967674
16970864 is a 371 of PCT/CN2020/077638 03/03/2020

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

03/26/2024

STATE OR COUNTRY

CHINA

ADDRESS

MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314
UNITED STATES

FILING FEE RECEIVED

\$1,820

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L11	3	("20060035144" OR "20060147803" OR "9812739").pn.	(US-PGPUB; USPAT)	ADJ	ON	ON	2025/02/25 02:05 PM
L12	3296	H01M\$.cpc. AND battery AND (electrolyte WITH nitrile)	(US-PGPUB; USPAT)	ADJ	ON	ON	2025/02/25 02:05 PM
L13	19627	H01M\$.cpc. AND battery AND (electrolyte WITH nitrile)	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2025/02/25 02:05 PM
L14	9741	H01M\$.cpc. AND battery AND (electrolyte WITH nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper)))	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2025/02/25 02:05 PM
L15	802	H01M\$.cpc. AND battery AND (electrolyte WITH nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper))) AND ((current collector) WITH tab)	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2025/02/25 02:05 PM
L16	642	H01M10/0525,0567,0569.cpc. AND battery AND (electrolyte WITH	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH,	ADJ	ON	ON	2025/02/25 02:05 PM

02/26/2025 09:01:25 AM
Workspace: 18607737 Zhang

Page 1 of 3
KA

L17	29	nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper))) AND ((current collector) WITH tab)	CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2025/02/25 02:05 PM
L18	30781	H01M10/0525,0567,0569.cpc. AND battery AND (electrolyte WITH nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper))) AND ((current collector) WITH tab) AND ((current collector) WITH (coated AND uncoated))	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2025/02/25 02:05 PM
L19	1849	ningde.as,aanm.	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2025/02/25 02:05 PM
L20	989	ningde.as,aanm. AND battery AND electrolyte AND nitrile	(US-PGPUB; USPAT; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))	ADJ	ON	ON	2025/02/25 02:05 PM

			CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN))				
--	--	--	--	--	--	--	--

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	6	H01M10/0525,0567,0569.cpc. AND battery AND (electrolyte WITH nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper))) AND ((current collector) WITH tab).clm.	(US-PGPUB; USPAT)	ADJ	ON	ON	2025/02/26 08:58 AM
N2	1	H01M10/0525,0567,0569.cpc. AND battery AND (electrolyte WITH nitrile) AND ((anode OR negative) WITH (current collector WITH (Cu OR copper))) AND ((current collector) WITH tab) AND ((current collector) WITH (coated AND uncoated)).clm.	(US-PGPUB; USPAT)	ADJ	ON	ON	2025/02/26 08:59 AM



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

62008 7590 03/10/2025
MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

EXAMINER

APICELLA, KARIE O

ART UNIT PAPER NUMBER

1725

DATE MAILED: 03/10/2025

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/607,737	03/18/2024	Lilan ZHANG	14850267COA	7065

TITLE OF INVENTION: ELECTROLYTE AND ELECTROCHEMICAL DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1290	\$0.00	\$0.00	\$1290	06/10/2025

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

62008 7590 03/10/2025
MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/607,737	03/18/2024	Lilan ZHANG	14850267COA	7065

TITLE OF INVENTION: ELECTROLYTE AND ELECTROCHEMICAL DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1290	\$0.00	\$0.00	\$1290	06/10/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
APICELLA, KARIE O	1725	429-217000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) The names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____
- (2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____
- 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

- ☐ Electronic Payment via the USPTO patent electronic filing system ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)
- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. Change in Entity Status (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
- ☐ Applicant asserting small entity status. See 37 CFR 1.27
- ☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/607,737	03/18/2024	Lilan ZHANG	14850267COA	7065
62008	7590	03/10/2025	EXAMINER	
MAIER & MAIER, PLLC 345 SOUTH PATRICK STREET ALEXANDRIA, VA 22314			APICELLA, KARIE O	
			ART UNIT	PAPER NUMBER
			1725	
DATE MAILED: 03/10/2025				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.** Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).

<https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf>

Routine uses of the information in this record may include disclosure to:

- 1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;
- 2) a federal, state, local, or international agency, in response to its request;
- 3) a contractor of the USPTO having need for the information in order to perform a contract;
- 4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
- 5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;
- 6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
- 7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
- 8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));
- 9) the Office of Personnel Management (OPM) for personnel research purposes; and
- 10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Notice of Allowability	Application No. 18/607,737	Applicant(s) ZHANG et al.	
	Examiner KARIE O APICELLA	Art Unit 1725	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to amendments filed on December 24, 2024.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 1-19. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☐ All b) ☐ Some* c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)	5. ☐ Examiner's Amendment/Comment
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.	6. ☒ Examiner's Statement of Reasons for Allowance
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.	7. ☐ Other _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.	

/KARIE O'NEILL APICELLA/ Primary Examiner, Art Unit 1725	
---	--

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.
2. The Applicant's amendments filed on December 24, 2024, were received. Claims 1, 2, 14 and 15 have been amended. None of the Claims have been cancelled, withdrawn from consideration, or added as new. Therefore, Claims 1-19 are pending in this office action.
3. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued on September 24, 2024.

Claim Rejections - 35 USC § 103

4. The rejection of Claims 1-2 and 14-16 under 35 U.S.C. 103 as being unpatentable over Kim et al. (US 2006/0147803 A1), has been overcome based on the amendments to the Claims and the arguments presented on pages 9-13 of the Remarks dated December 24, 2024.
5. The rejection of Claims 3-13 and 17-19 under 35 U.S.C. 103 as being unpatentable over Kim et al. (US 2006/0147803 A1), as applied to Claims 1-2 and 14-16 above, and in further view of Kefei (US 9,812,739), has been overcome based on the

amendments to the Claims and the arguments presented on pages 9-13 of the Remarks dated December 24, 2024.

Allowable Subject Matter

6. Claims 1-19 are allowed.
7. The following is an examiner's statement of reasons for allowance: with regard to independent Claims 1 and 14, the closest prior art, Kim et al. (US 2006/0147803 A1), teach an electrochemical device, comprising: a positive electrode, a negative electrode, a separator, and an electrolyte; wherein the electrolyte comprises a nitrile compound, and a mass percentage of the nitrile compound in the electrolyte, A%, is 0.1% to 10%; the negative electrode comprises a current collector, wherein the current collector comprises a first region and a second region; and, a negative electrode active substance layer is provided only in the first region. The closest prior art do not teach, fairly suggest or render obvious wherein an area of the second region, B%, is 0.4% to 54% of a surface area of the current collector; and $A \times B < 600$.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to KARIE O APICELLA whose telephone number is

(571)272-8614. The examiner can normally be reached Monday thru Friday; 8:00AM to 5:00PM EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nicole Buie-Hatcher can be reached on 571-270-3879. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: <https://patentcenter.uspto.gov>. Visit <https://www.uspto.gov/patents/apply/patent-center> for more information about Patent Center and <https://www.uspto.gov/patents/docx> for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/KARIE O'NEILL APICELLA/
Primary Examiner, Art Unit 1725



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/607,737	03/18/2024	Lilan ZHANG	14850267COA	7065
62008	7590	03/20/2025		
MAIER & MAIER, PLLC 345 SOUTH PATRICK STREET ALEXANDRIA, VA 22314			EXAMINER APICELLA, KARIE O	
			ART UNIT	PAPER NUMBER
			1725	
			NOTIFICATION DATE	DELIVERY MODE
			03/20/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docket@maierandmaier.com
maierandmaier_PAIR@firsttofile.com



UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Application No. : 18607737
Applicant : Zhang
Filing Date : 03/18/2024
Date Mailed : 03/20/2025

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

*A copy of this notice **MUST** be returned with the reply. Please address response to
"Mail Stop Issue Fee, Commissioner for Patents,
P.O. Box 1450, Alexandria, VA 22313-1450".*

/Marsha Palmer-Lee/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 18607737

**IDENTIFICATION OF APPLICATION DEFICIENCIES
IN APPLICATION FILED ON OR AFTER SEPTEMBER 16, 2012**

- ☐ Applicant must provide legible text for the following item(s).
- ☐ Specification filed , page(s) .
- ☐ Claims filed , claim(s) .
- ☐ Other: .
- ☒ Applicant must provide missing information on the following page(s) of the specification by amending the specification to add the missing text. No new matter may be added.
Page/line no(s). ABST last line is incomplete
- ☐ The specification refers to one or more applications by attorney docket number and does not show the U.S. application number(s). Applicant must supply the U.S. application number in place of each attorney docket number.
Page/line no(s).
- ☐ Applicant must provide an Abstract of the Disclosure.
- ☐ The Application Data Sheet (ADS dated) does not supply the inventor's city and/or does not supply the inventor's U.S. state and/or does not supply the inventor's country. Applicant must submit a signed, in accordance with 37 CFR 1.76(e) and 1.33(b), application data sheet that corrects this deficiency. To be in compliance with 37 CFR 1.76, the corrected application data sheet must identify the information being changed by using underlining for additions and strikethroughs or brackets for deletions.
- ☐ Other:

The response to this notice should contain only amended papers, as the waiver of 37 CFR 1.312 is limited to corrections of documents specifically requested in the notice.

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

<i>In re</i> Patent Application of: Ningde Ampere Technology Limited	Confirmation No.: 7065
U.S. Patent Application No.: 18/607,737	Art Unit: 1725
Filed: March 18, 2024	Examiner: KARIE O APICELLA
Title: ELECTROLYTE AND ELECTROCHEMICAL DEVICE	Attorney Docket No.: 14850267COA
NOA Mailed: March 10, 2025 IF Due: June 10, 2025 <u>(not paid)</u>	

AMENDMENT UNDER 37 CFR 1.312

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

March 24, 2025

Dear Commissioner:

In response to the Notice to File Corrected Application Papers mailed March 20, 2025, and based on 37 CFR 1.312 (Rule 312), Applicant respectfully requests reconsideration of the Application in view of the following Amendments and Remarks.

Amendments to the Abstract begin on page 2.

Remarks follow the above-mentioned amendments.

AMENDMENTS TO THE ABSTRACT

The original Abstract is canceled in favor of the new Abstract presented on the following page.

ABSTRACT

An electrochemical device, including a positive electrode, a negative electrode, a separator and an electrolyte. The electrolyte includes a nitrile compound, and the mass percentage of the nitrile compound in the electrolyte is A%; the negative electrode includes a current collector, wherein the current collector includes a first region and a second region; the first region is provided with a negative electrode active substance layer; the second region does not include a negative electrode active substance layer; the area of the second region is B% of the surface area of the current collector; and $A \times B < 600$.

REMARKS

Favorable consideration of this Amendment is respectfully requested.

The abstract has been amended to complete the last line as required by the Notice to File Corrected Application Papers Notice.

Moreover, given their formal nature, Applicant submits that no new matter has been introduced by the foregoing amendments.

CONCLUSION

Based on the above discussion, Applicant therefore respectfully requests entry of the present amendment to the Application. The Application, as amended, is believed to remain in condition of allowance. An early and favorable action to that effect is respectfully requested.

Respectfully submitted,

Maier & Maier, PLLC
345 South Patrick Street
Alexandria, Virginia 22314
(703) 740-8322
Customer No. 62008

/Timothy J. Maier/
Timothy J. Maier
Attorney of Record
Reg. No. 51986

TJM/mag

March 24, 2025



UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #
18/607,737

RECEIPT DATE / TIME
03/24/2025 10:09:42 AM Z ET

ATTORNEY DOCKET #
14850267COA

Title of Invention

ELECTROLYTE AND ELECTROCHEMICAL DEVICE

Application Information

APPLICATION TYPE Utility - Nonprovisional Application
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 7065

FILED BY Mark Gambriel

PATENT CENTER # 69699987

FILING DATE 03/18/2024

CUSTOMER # 62008

FIRST NAMED
INVENTOR Lilan ZHANG

CORRESPONDENCE
ADDRESS -

AUTHORIZED BY Timothy Maier

Documents

TOTAL DOCUMENTS: 4

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
PAT201908032US2_312 Amendment.pdf		5	-	134 KB
PAT201908032US2_312 Amendment-A.NA.pdf	(1-1)	1	Amendment after Notice of Allowance (Rule 312)	53 KB
PAT201908032US2_312 Amendment-ABST.pdf	(2-3)	2	Abstract	40 KB
PAT201908032US2_312 Amendment-REM.pdf	(4-5)	2	Applicant Arguments/Remarks Made in an Amendment	52 KB
PAT201908032US2_Respon se_NTFCAP.pdf		1	Post Allowance Communication - Incoming	62 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
PAT201908032US2_312 Amendment.pdf	DD8EC9E84F2D89062CC2F5518FD63CAF647D9E6F79DA4204 5316F3DC7817EBDC64B840424AA6B4A937B273AD038631AE8 45C23F72552D4437009697DB371D331
PAT201908032US2_312 Amendment-A.NA.pdf	0C3B2E298F3A6F9D4F0C3F1C3214BF83147D2A432B055906B C5D3882210BCFA1D759BAB6A792A9F489CFF95F111009D25C 057845F33349A0519E7D7AB800D318
PAT201908032US2_312 Amendment-ABST.pdf	366FE5B6016F14698A3A8CA423378530AAD304457B9245F9D6 6CD2D2C886FD7D0F27458A0B07D03C28D9CA3F31A86CE9E C414879199A6D90D1A50DC2869E11E0
PAT201908032US2_312 Amendment-REM.pdf	A45EBABEA9961AB64D358AF9EB971F68EFC0D0575834857938 FAC0E828E36B9C725829AE7148A08E3CA637E739D1AC8EF8 BCA8A5EE98243499B083523C7F708E5
PAT201908032US2_Response _NTFCAP.pdf	D8C4E799042FE2005467BDFAC0E71F34A77056BEC470A4BD 104ADD3866BDDF32BC4EB3D6D0F20C94D5742E80452C2BAA 4C10BAA0232C5C6E747FAD85D2AF1847

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

<i>In re</i> Patent Application of: Ningde Ampere Technology Limited	Confirmation No.: 7065
U.S. Patent Application No.: 18/607,737	Art Unit: 1725
Filed: March 18, 2024	Examiner: KARIE O APICELLA
Title: ELECTROLYTE AND ELECTROCHEMICAL DEVICE	Attorney Docket No.: 14850267COA
NOA Mailed: March 10, 2025 IF Due: June 10, 2025 (<u>not paid</u>)	

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS

Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

March 24, 2025

Dear Commissioner:

In response to the Notice to File Corrected Application Papers dated March 20, 2025, Applicant hereby submits an Amendment Under 37 CFR 1.312 which completes the Abstract as required by the Notice. No new matter is introduced by the present submission. No fee is believed due in connection with this submission. If there is a fee due, please notify the undersigned Attorney for Applicant. Applicant believes that the instant case is now ready for examination on the merits

MAIER & MAIER, PLLC
345 South Patrick Street
Alexandria, VA 22314
(703) 740-8322
Customer No. 62008

Respectfully submitted,

/Timothy J. Maier/
Timothy J. Maier
Attorney of Record
Reg. No. 51986

TJM/mag

Attachments:
Amendment Under 37 CFR 1.312



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/607,737	03/18/2024	Lilan ZHANG	14850267COA	7065
62008	7590	04/02/2025	EXAMINER	
MAIER & MAIER, PLLC 345 SOUTH PATRICK STREET ALEXANDRIA, VA 22314			APICELLA, KARIE O	
			ART UNIT	PAPER NUMBER
			1725	
			NOTIFICATION DATE	DELIVERY MODE
			04/02/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docket@maierandmaier.com
maierandmaier_PAIR@firsttofile.com

Response to Rule 312 Communication	Application No. 18/607,737	Applicant(s) ZHANG et al.	
	Examiner KARIE O APICELLA	Art Unit 1725	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

1. ☒ The amendment filed on 24 March 2025 under 37 CFR 1.312 has been considered, and has been:

a) ☒ entered.

b) ☐ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.
Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

f) ☐ not entered because the supplemental or corrected Application Data sheet (ADS)

☐ was not accompanied by a petition to accept an unintentionally delayed claim under 37 CFR 1.55 or 27 CFR 1.78;

☐ did not identify the information being changed in accordance with 37 CFR 1.76(c)(2);

☐ was not properly signed in accordance with 37 CFR 1.76(e) (or 37 CFR 1.33(b) for applications filed prior to September 16, 2012).

/KARIE O'NEILL APICELLA/ Primary Examiner, Art Unit 1725	
---	--

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

<i>In re</i> Patent Application of: Ningde Ampere Technology Limited	Confirmation No.: 7065
U.S. Patent Application No.: 18/607,737	Art Unit: 1725
Filed: March 18, 2024	Examiner: KARIE O APICELLA
Title: ELECTROLYTE AND ELECTROCHEMICAL DEVICE	Attorney Docket No.: 14850267COA
NOA Mailed: March 10, 2025 IF Due: June 10, 2025 <u>(not paid)</u>	

AMENDMENT UNDER 37 CFR 1.312

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

March 24, 2025

Dear Commissioner:

In response to the Notice to File Corrected Application Papers mailed March 20, 2025, and based on 37 CFR 1.312 (Rule 312), Applicant respectfully requests reconsideration of the Application in view of the following Amendments and Remarks.

Amendments to the Abstract begin on page 2.

Remarks follow the above-mentioned amendments.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

62008 7590 03/10/2025
MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/607,737	03/18/2024	Lilan ZHANG	14850267COA	7065

TITLE OF INVENTION: ELECTROLYTE AND ELECTROCHEMICAL DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1290	\$0.00	\$0.00	\$1290	06/10/2025
EXAMINER		ART UNIT	CLASS-SUBCLASS			
APICELLA, KARIE O		1725	429-217000			

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Maier & Maier, PLLC

2

3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

Ningde Amperex Technology Limited

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Ningde, CHINA

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: (Please first reapply any previously paid fee shown above)

☒ Electronic Payment via the USPTO patent electronic filing system ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge ~~XXXXXXX~~, any deficiency, or credit any overpayment to Deposit Account No. 50-5976

5. Change in Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Timothy J. Maier/

Date May 13, 2025

Typed or printed name Timothy J. Maier

Registration No. 51986



UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC PAYMENT RECEIPT

APPLICATION #
18/607,737

RECEIPT DATE / TIME
05/13/2025 10:41:50 AM Z ET

ATTORNEY DOCKET #
14850267COA

Title of Invention

ELECTROLYTE AND ELECTROCHEMICAL DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	7065	FILED BY	Fumiko Enoki
PATENT CENTER #	70403605	AUTHORIZED BY	Timothy Maier
CUSTOMER #	62008	FILING DATE	03/18/2024
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Lilan ZHANG

Payment Information

PAYMENT METHOD CARD / 8716		PAYMENT TRANSACTION ID E20255CA42498746	PAYMENT AUTHORIZED BY Fumiko Enoki	
--------------------------------------	--	---	--	--

FEE CODE	DESCRIPTION	ITEM PRICE(\$)	QUANTITY	ITEM TOTAL(\$)
1501	UTILITY ISSUE FEE	1290.00	1	1290.00
TOTAL AMOUNT:				\$1,290.00

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #
18/607,737

RECEIPT DATE / TIME
05/13/2025 10:41:50 AM Z ET

ATTORNEY DOCKET #
14850267COA

Title of Invention

ELECTROLYTE AND ELECTROCHEMICAL DEVICE

Application Information

APPLICATION TYPE Utility - Nonprovisional Application
under 35 USC 111(a)

PATENT # -

CONFIRMATION # 7065

FILED BY Fumiko Enoki

PATENT CENTER # 70403605

FILING DATE 03/18/2024

CUSTOMER # 62008

FIRST NAMED
INVENTOR Lilan ZHANG

CORRESPONDENCE
ADDRESS -

AUTHORIZED BY Timothy Maier

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
Issue Fee Transmittal.pdf	1	Issue Fee Payment (PTO-85B)	212 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
Issue Fee Transmittal.pdf	D6882B46C552CB3E675846E5F5749E21ED5DDE29B170E6E31 BCDE249215FA6DBCE9A8276080064A5FCCCCC6A4BFE21E FE0936722D38ACFCE24D9EC3807C4B0F

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

Zhuhai CosMX Battery Co. - EX1002
Zhuhai CosMX Battery Co. v. Ningde Ampere Tech. Ltd.
IPR2026-00402 - Page 200 of 205

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/607,737	06/17/2025	12334494	14850267COA	7065
62008	7590	06/04/2025		
MAIER & MAIER, PLLC 345 SOUTH PATRICK STREET ALEXANDRIA, VA 22314				

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at <https://patentcenter.uspto.gov/>. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at <https://certifiedcopycenter.uspto.gov/index.html>. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (<https://patentcenter.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PATENT CENTER site <https://patentcenter.uspto.gov> for additional inventors):

Lilan ZHANG, Ningde, CHINA;
Chao TANG, Ningde, CHINA;
Jianming ZHENG, Ningde, CHINA;

APPLICANT(s) (Please see PATENT CENTER site <https://patentcenter.uspto.gov> for additional applicants):

Ningde Ampere Technology Limited, Ningde, CHINA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit [SelectUSA.gov](https://selectusa.gov).



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/607,737	03/18/2024	Lilan ZHANG	14850267COA	7065
62008	7590	06/17/2025	EXAMINER	
MAIER & MAIER, PLLC 345 SOUTH PATRICK STREET ALEXANDRIA, VA 22314			APICELLA, KARIE O	
			ART UNIT	PAPER NUMBER
			1725	
			NOTIFICATION DATE	DELIVERY MODE
			06/17/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docket@maierandmaier.com
maierandmaier_PAIR@firsttofile.com



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.
18/607,737	17-Jun-2025	12334494

MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at <https://patentcenter.uspto.gov>

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit <https://www.uspto.gov/electronicgrants>