AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Central District of California on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
8:22-CV-1874	10/13/2022	Central District of California

PLAINTIFF	DEFENDANT
RJ Technology LLC	Apple Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,749,641	7/6/2010	RJ Technology LLC
2			
3			
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		Patent Listed Above
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-401	10/13/2022	Eastern District of Texas

PLAINTIFF	DEFENDANT
RJ Technology LLC	Samsung Electronics America, Inc. Samsung Electronics Co., Ltd

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,749,641	7/6/2010	RJ Technology LLC
2			
3			
4			
5			

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

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
10/491,134	05/06/2004	Xiaoping Ren	042787-0106

CONFIRMATION NO. 7003

POWER OF ATTORNEY NOTICE

22428
FOLEY & LARDNER LLP
3000 K STREET N.W.
SUITE 600
WASHINGTON, DC 20007-5109

OC000000136461694

Date Mailed: 10/03/2022

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/28/2022.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/nrhayden/

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
10/491,134	05/06/2004	Xiaoping Ren	3957.0000G

CONFIRMATION NO. 7003

27896
EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878

POA ACCEPTANCE LETTER

OC000000136461695

Date Mailed: 10/03/2022

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/28/2022.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/nrhayden/

PTO/AIA/81A (02-15)
Approved for use through 03/31/2021. OMB 0651-0035
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 displays a valid OMB control number

PATENT - POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Patent Number	7,749,641
Issue Date	July 6, 2010
First Named Inventor	Xiaoping REN
Title	Secondary Lithium Ion Cell or Battery, and Protecting Circuit, Electronic Device, and Charging Device of the Same
Attorney Docket No.	3957.0000G

I hereby revoke all previous powers of attorney given in the above-identified patent.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the Customer Number identified in the box at right as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: 27896

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified patent to:

☒ The address associated with the above-identified Customer Number.

OR

☐ The address associated with the Customer Number identified in the box at right:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant.

OR

☒ Patent owner.

Statement under 37 CFR 3.73(c) (Form PTO/AIA/96) submitted herewith or filed on _____.

SIGNATURE of Applicant or Patent Owner

Signature	/Xiaoping Ren/	Date	September 20, 2022
Name	Xiaoping Ren	Telephone	
Title and Company	Owner, RJ Technology LLC		

NOTE: Signatures of all the applicants or patent owners of the entire interest or their representative(s) are required. If more than one signature is required, submit multiple forms, check the box below, and identify the total number of forms submitted in the blank below.

☑ A total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 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.

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.

PTO/AIA/96 (08-12)
Approved for use through 11/30/2020. 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 displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: RJ Technology LLC

Application No./Patent No.: 7,749,641 Filed/Issue Date: July 6, 2010

Titled: Secondary Lithium Ion Cell or Battery, and Protecting Circuit, Electronic Device, and Charging Device of the Same

RJ Technology, a Delaware limited liability company

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☑ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 061222, Frame 0846, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

   2. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(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.

PTO/AIA/96 (08-12)
Approved for use through 11/30/2020. 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 displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Xiaoping REN/	Septermber 20, 2022
Signature	Date
Xiaoping REN	Owner, RJ Technology LLC
Printed or Typed Name	Title or Registration Number

[Page 2 of 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.

Electronic Acknowledgement Receipt	
EFS ID:	46710423
Application Number:	10491134
International Application Number:	
Confirmation Number:	7003
Title of Invention:	SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE, AND CHARGING DEVICE OF THE SAME
First Named Inventor/Applicant Name:	Xiaoping Ren
Customer Number:	22428
Filer:	Mark James DeBoy/Stephanie Jeppi
Filer Authorized By:	Mark James DeBoy
Attorney Docket Number:	042787-0106
Receipt Date:	28-SEP-2022
Filing Date:	06-MAY-2004
Time Stamp:	16:06:43
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	FINAL_SIGNED_REN_RJ_Technology_POA.pdf	154553 a87db5aaa098afc3d25d6b5ae25fb049629a8f98	no	2
Warnings:					

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	2022_09_20_FINAL_SIGNED_373_Statement.pdf	114314 69a80c68dd74c1464a4edc4222f3c27ebfadb73b	no	3
Warnings:					
Information:					
			Total Files Size (in bytes):	268867	

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 a 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.
10/491,134	07/06/2010	7749641	042787-0106	7003

22428 7590 06/16/2010

FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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 1561 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 Application Information Retrieval (PAIR) WEB site (http://pair.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 Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Xiaoping Ren, Beijing, CHINA;
Jie Sun, Beijing, CHINA;

IR103 (Rev. 10/09)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (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 including the Patent, advance orders and notification of maintenance fees 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.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

FOLEY & LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON DC 20007

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 facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/491,134	05/06/2004	Xiaoping REN	042787-0106	7003

TITLE OF INVENTION:

SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE, AND CHARGING DEVICE OF THE SAME

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
NONPROVISIONAL	YES	$755	$300	$0	$1055	5/24/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
SIDDIQUEE, MUHAMMAD S	1795	429-050000

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/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form 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 Stephen A. Bent
2 FOLEY & LARDNER LLP
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 has been filed for recordation as set forth in 37 CFR 3.11. 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. The following fee(s) are submitted:
- ☑ Issue Fee
- ☑ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ☐ A check is enclosed.
- ☑ Payment by credit card. Form PTO-2038 is attached.
- ☑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 19-0741 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.
- ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature S. G. Bent Date May 20, 2010

Typed or printed name Stephen A. Bent Registration No. 29,768

This collection of information 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 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, 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.

Electronic Patent Application Fee Transmittal	
Application Number:	10491134
Filing Date:	06-May-2004
Title of Invention:	SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE, AND CHARGING DEVICE OF THE SAME
First Named Inventor/Applicant Name:	Xiaoping Ren
Filer:	Stephen A. Bent
Attorney Docket Number:	042787-0106
Filed as Small Entity	

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl issue fee	2501	1	755	755
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1055**

Electronic Acknowledgement Receipt	
EFS ID:	7654244
Application Number:	10491134
International Application Number:	
Confirmation Number:	7003
Title of Invention:	SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE, AND CHARGING DEVICE OF THE SAME
First Named Inventor/Applicant Name:	Xiaoping Ren
Customer Number:	22428
Filer:	Stephen A. Bent/BARBIE BEAVERS
Filer Authorized By:	Stephen A. Bent
Attorney Docket Number:	042787-0106
Receipt Date:	20-MAY-2010
Filing Date:	06-MAY-2004
Time Stamp:	17:28:57
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$1055
RAM confirmation Number	4039
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Issue Fee Payment (PTO-85B)	issuefee.pdf	87967 d93b06577916fcea945369178c5a2b31b9366be0	no	1
Warnings:					
Information:					
2	Fee Worksheet (PTO-875)	fee-info.pdf	32111 87fa3d69a2fcb5f06a5382711fcb0f322a4f03cf	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	120078	

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 a 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.

OIPE JC25 OCT 21 2004 PATENT & TRADEMARK OFFICE

MODIFIED PTO/SB/08 (08-00)
Approved for use through 10/31/2002. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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Substitute for form PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Date Submitted: October 21, 2004

(use as many sheets as necessary)

Sheet	1	of	1

Complete if Known	
Application Number	10/491,134
Filing Date	05/06/2004
First Named Inventor	Xiaoping REN
Group Art Unit	1745
Examiner Name	Melissa J. Austin
Attorney Docket Number	042787-0106

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	U.S. Patent Document Number	U.S. Patent Document Kind Code[2] (if known)	Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/M.S./	A1	5,604,418		Alcatel Alsthom Compagnie Generale Andrieu et al.	2/18/1997	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Office[3]	Number[4]	Kind Code[5] (if known)	Name of Patentee or Applicant of Cited Documents	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
/M.S./	A2		CN 1135103 A			11/06/1996		
/M.S./	A3		CN 1185860 A			6/24/1998		
/M.S./	A4		JP 2000-270491 A			9/29/2000		

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]
/M.S./	A5	International Search Report Dated: 5/6/2003	

Examiner Signature	/Muhammad Siddiquee/	Date Considered	02/10/2010

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

[1] Unique citation designation number. [2]See attached Kinds of U.S. Patent Documents. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, 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.

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

22428 7590 02/22/2010

FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

EXAMINER	
SIDDIQUEE, MUHAMMAD S	
ART UNIT	PAPER NUMBER
1795	

DATE MAILED: 02/22/2010

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/491,134	05/06/2004	Xiaoping Ren	042787-0106	7003

TITLE OF INVENTION: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE, AND CHARGING DEVICE OF THE SAME

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	05/24/2010

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 SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

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 and an extra copy of the form should be submitted. 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: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (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 including the Patent, advance orders and notification of maintenance fees 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.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

22428 7590 02/22/2010

FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

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 facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)

(Signature)

(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/491,134	05/06/2004	Xiaoping Ren	042787-0106	7003

TITLE OF INVENTION: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE, AND CHARGING DEVICE OF THE SAME

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	$755	$300	$0	$1055	05/24/2010

EXAMINER	ART UNIT	CLASS-SUBCLASS
SIDDIQUEE, MUHAMMAD S	1795	429-050000

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/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form 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 _____

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 has been filed for recordation as set forth in 37 CFR 3.11. 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. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information 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 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, 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.

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.
10/491,134	05/06/2004	Xiaoping Ren	042787-0106	7003

22428 7590 02/22/2010

FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

EXAMINER	
SIDDIQUEE, MUHAMMAD S	
ART UNIT	PAPER NUMBER
1795	

DATE MAILED: 02/22/2010

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 1023 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 1023 day(s).

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 Application Information Retrieval (PAIR) WEB site (http://pair.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 Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

Notice of Allowability	Application No.	Applicant(s)	
	10/491,134	REN ET AL.	
	Examiner	Art Unit	
	MUHAMMAD SIDDIQUEE	1795	

-- 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 *11/13/2009*.

2. ☒ The allowed claim(s) is/are *1-10 and 18-25*.

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

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ 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)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 11/13/2009
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/Muhammad Siddiquee/
Examiner, Art Unit 1795

DETAILED ACTION

Response to Arguments

1. Applicant's arguments, see pages 6-12, filed 11/13/2009, with respect to claims 1-10 have been fully considered and are persuasive. The rejection of claims 1-10 has been withdrawn.

Reasons for Allowance

2. Claims 1-10 and 18-25 are allowed.

3. The following is an examiner's statement of reasons for allowance:

The closest prior art of record (US 5,260,148; US 5,487,960; JP 2001-176559) do not anticipate or suggest or render obvious the invention as recited in the independent claims.

While US '260 and US '960 teaches a battery with electrode material capacity ratio and charge cut-off voltage, neither US '960 nor the remaining prior art of record would reasonably lead one of ordinary skill in the art to arrive at the invention as currently claimed. For example, the prior art of record does not reasonably teach or suggest of the claimed battery/method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that the charge cut-off voltage of the secondary lithium ion cell or battery is greater than 4.2 V but less than 5.8 V; and a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5, as calculated by a specific capacity with a charge voltage limited to 4.2 V. And there is nothing taught by the prior art of record to reasonably arrive at the claimed configuration. Moreover,

JP '559 teaches that life cycle property of a cell drastically decreases when the charging voltage increases beyond 4.2V. Accordingly, one of ordinary skill at the time of invention would not have predicted that the resulting cell would have high capacity.

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."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MUHAMMAD SIDDIQUEE whose telephone number is (571) 270-3719. The examiner can normally be reached on Monday-Thursday, 7:30 am to 4:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Muhammad Siddiquee/
Examiner, Art Unit 1795

/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1795

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/21/2008	07/12/2008	01/12/2009	08/11/2009	01/14/2010				
	1	÷	✓	✓	✓	=				
	2	÷	✓	✓	✓	=				
	3	÷	✓	✓	✓	=				
	4	÷	✓	✓	✓	=				
	5	÷	✓	✓	O	=				
	6	÷	✓	✓	O	=				
	7	÷	✓	✓	O	=				
	8	÷	✓	✓	O	=				
	9	÷	✓	✓	O	=				
	10	÷	✓	✓	O	=				
	11	÷	N	N	N	-				
	12	÷	N	N	N	-				
	13	÷	N	N	N	-				
	14	÷	N	N	N	-				
	15	÷	N	N	N	-				
	16	÷	N	N	N	-				
	17	÷	N	N	N	-				
	18				O	=				
	19				O	=				
	20				O	=				
	21				O	=				
	22					=				
	23					=				
	24					=				
	25					=				

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S76	3	(capacity ratio or specific capacity) with "400" cycle	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 09:13
S77	859	(capacity ratio or specific capacity) with cycle	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 09:14
S78	1	"5487960".pn.	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 09:57
S82	2	US-5604418-$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2010/01/14 18:36
S83	18851	(charge near5 ((cut-off or cut off) near5 voltage) or ((cut-off or cut off) near5 voltage))	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:43
S84	16890	"320"/$.ccls.	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:44
S85	596	S83 and S84	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:44
S86	1	S85 and (capacity ratio or specific capacity) with cycle	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:46
S87	17	S85 and (capacity ratio or specific capacity)	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:46
S88	1109	429/49,50.ccls.	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:47
S89	16	S83 and S88	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:47

S90	51	S88 and (capacity ratio or specific capacity)	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:48
S91	785	"320"/137.ccls.	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:49
S92	21	S83 and S91	US-PGPUB; USPAT; USOCR	NEAR	ON	2010/01/14 18:49

1/14/2010 8:46:13 PM
C:\Documents and Settings\msiddiquee\My Documents\EAST\Workspaces\10491134 7-7-08.wsp

PTO/SB/08 (09-06)
Approved for use through 03/31/2007. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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Substitute for form 1449/PTO				*Complete if Known*	
SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT BY APPLICANT				**Application Number**	10/491,134
Date Submitted: November 13, 2009				**Filing Date**	05/06/2004
				First Named Inventor	Xiaoping REN
(use as many sheets as necessary)				Art Unit	1795
				Examiner Name	Muhammad S. Siddiquee
Sheet	1	of	1	Attorney Docket Number	042787-0106

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number / Number-Kind Code[2] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

UNPUBLISHED U.S. PATENT APPLICATION DOCUMENTS

Examiner Initials*	Cite No.[1]	U.S. Patent Application Document / Serial Number-Kind Code[2] (*if known*)	Filing Date of Cited Document MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document / Country Code[3]-Number[4]-Kind Code[5] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]
/M.S./		Office Action dated June 9, 2009, in corresponding Japanese Application No. 2003-533374, English Translation 3 pages	
/M.S./		Patent Abstracts of Japan Publication No. 2001-176559 dated June 29, 2001, *ABSTRACT*	
/M.S./		Patent Abstracts of Japan Publication No. 09-259928 dated October 3, 1977, *ABSTRACT*	

Examiner Signature	/Muhammad Siddiquee/	Date Considered	01/14/2010

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. 3 Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). 4 For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. 5 Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. 6 Applicant is to place a check mark here if English language Translation is attached. 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 2 hours 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, 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 (1-800-786-9199) and select option 2.

WASH_6580623.1

OIPE JC25
OCT 2 1 2004
PATENT & TRADEMARK OFFICE

JTV

Atty. Dkt. No. 042787-0106

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Xiaoping REN et al.

Title: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

Appl. No.: 10/491,134

Filing Date: May 6, 2004

Examiner: Melissa J. Austin

Art Unit: 1745

INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR §1.56

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

Sir:

Submitted herewith on Form PTO/SB/08 is a listing of documents known to Applicants in order to comply with Applicants' duty of disclosure pursuant to 37 CFR §1.56. A copy of each listed document is being submitted to comply with the provisions of 37 CFR §1.97 and §1.98.

The submission of any document herewith, which is not a statutory bar, is not intended as an admission that such document constitutes prior art against the claims of the present application or that such document is considered material to patentability as defined in 37 CFR §1.56(b). Applicants do not waive any rights to take any action which would be appropriate to antedate or otherwise remove as a competent reference any document which is determined to be a *prima facie* art reference against the claims of the present application.

TIMING OF THE DISCLOSURE

The listed documents are being submitted in compliance with 37 CFR §1.97(b), before the mailing date of the first Office Action on the merits.

The PTO did not receive the following listed item(s) References marked as Asterisk cc. *11

RELEVANCE OF EACH DOCUMENT

Any document listed on the attached PTO/SB/08 was cited as being relevant during the prosecution of the corresponding International application. A copy of the International Search Report is attached setting forth the portion of each document considered relevant by the examiner. A copy of the documents cited in the Search Report are not being submitted herewith. An English-language counterpart of the foreign-language documents has not been provided. The absence of a translation or an English-language counterpart document does not relieve the PTO from its duty to consider any submitted document (37 CFR §1.98 and MPEP§609).

Applicants respectfully request that any listed document be considered by the Examiner and be made of record in the present application and that an initialed copy of Form PTO/SB/08 be returned in accordance with MPEP §609.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 CFR §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

Respectfully submitted,

Date 21 October 2004

By S. A. Bent

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

OIPE JC25 OCT 21 2004 PATENT & TRADEMARK OFFICE

MODIFIED PTO/SB/08 (08-00)
Approved for use through 10/31/2002. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Date Submitted: October 21, 2004

(use as many sheets as necessary)

Sheet	1	of	1

Complete if Known	
Application Number	10/491,134
Filing Date	05/06/2004
First Named Inventor	Xiaoping REN
Group Art Unit	1745
Examiner Name	Melissa J. Austin
Attorney Docket Number	042787-0106

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	U.S. Patent Document Number	U.S. Patent Document Kind Code[2] (if known)	Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/M.S./	A1	5,604,418		Alcatel Alsthom Compagnie Generale	2/18/1997	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Office[3]	Number[4]	Kind Code[5] (if known)	Name of Patentee or Applicant of Cited Documents	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
/M.S./	A2		CN 1135103 A			11/06/1996		
/M.S./	A3		CN 1185860 A			6/24/1998		
/M.S./	A4		JP 2000-270491 A			9/29/2000		

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]
/M.S./	A5	International Search Report Dated: 5/6/2003	

Examiner Signature	/Muhammad Siddiquee/	Date Considered	02/10/2010

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

[1] Unique citation designation number. [2]See attached Kinds of U.S. Patent Documents. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, 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.

EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S93	1	(battery method improving capacity average operating voltage specific energy secondary lithium ion cell battery characterized charge cut-off voltage secondary lithium ion cell battery ratio positive electrode material negative electrode material secondary lithium ion cell "1:1.0 1:2.5" calculated specific capacity charge voltage limited "4.2 V"). clm.	US-PGPUB; USPAT; UPAD	AND	ON	2010/01/14 20:43

1/14/2010 8:46:35 PM
C:\Documents and Settings\msiddiquee\My Documents\EAST\Workspaces\10491134 7-7-08.wsp

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

ORIGINAL		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
429	50	H 0 1 M 10 / 44 (2006.01.01)	
CROSS REFERENCE(S)		H 0 2 J 7 / 00 (2006.01.01)	
		H 0 1 M 10 / 42 (2006.01.01)	
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)	H 0 1 M 4 / 58 (2010.01.01)	
429	49 231.6		
320	137		

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	-	17												
2	2	11	18												
3	3	12	19												
4	4	13	20												
5	5	14	21												
6	6	15	22												
7	7	16	23												
8	8	17	24												
9	9	18	25												
10	10														
-	11														
-	12														
-	13														
-	14														
-	15														
-	16														

/MUHAMMAD SIDDIQUEE/ Examiner.Art Unit 1795	01/15/2010	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/PATRICK RYAN/ Supervisory Patent Examiner.Art Unit 1795	01/17/2010	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	None

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

SEARCHED			
Class	Subclass	Date	Examiner
429	60, 231.95	7/11/2008	MSS
429	49, 50	1/14/2010	MSS
320	137	1/14/2010	MSS

SEARCH NOTES		
Search Notes	Date	Examiner
Consulted with Gregg Cantelmo in Art unit 1795	7/11/2008	MSS
Searched for Inventor in EAST and PALM (assignee info is not avaiable in PALM)	7/11/2008	MSS
Searched USPAT, US-PGPUB, EPO, JPO, DERWENT	7/11/2008	MSS
Class 429/60, 231.95 was limited by text, see EAST search history.	7/11/2008	MSS
Text Searched, see EAST search results.	1/9/2009	MSS
Consulted with Jonathan Crepeau in Art unit 1795	1/9/2009	MSS
Consulted with Jonathan Crepeau in Art unit 1795	8/11/2009	MSS
Consulted with Jonathan Crepeau in Art unit 1795	1/14/2010	MSS

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
USPGPUB/USPAT/UPAD Text Searched (attached)	Text searched (see EAST results)	1/14/2010	MSS

/MUHAMMAD SIDDIQUEE/ Examiner.Art Unit 1795	

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Xiaoping REN et al.
Title:	SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME
Appl. No.:	10/491,134
International Filing Date:	09/28/2002
371(c) Date:	05/06/2004
Examiner:	Muhammad S. Siddiquee
Art Unit:	1795
Confirmation Number:	7003

REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL

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

Sir:

This is a Request for Continued Examination (RCE) under 37 C.F.R. § 1.114 of the above-identified application. This RCE and the enclosed items listed below are being filed prior to the earliest of: (1) payment of the issue fee (unless a petition under 37 C.F.R. § 1.313 is granted); (2) abandonment of the application; or (3) the filing of a notice of appeal to the U.S.

Court of Appeals for the Federal Circuit under 35 U.S.C. §141, or the commencement of a civil action under 35 U.S.C. §145 or §146 (unless the appeal or civil action is terminated).

I. Submission required under 37 C.F.R. §1.114: (check items that apply)

a. Previously submitted:

[ ] Please enter and consider the amendment and/or reply previously filed on __.

[ ] Please consider the Affidavit(s)/Declaration(s) previously filed on __ but not considered.

[ ] Please consider the arguments in the Appeal Brief or Reply previously filed on __.

[ ] Other __.

b. Enclosed are:

[**X**] Amendment/Reply.

[ ] Affidavit(s)/Declaration(s).

[**X**] Information Disclosure Statement.

[**X**] Form PTO/SB/08 with copies of 2 listed reference(s).

[ ] Other .

Miscellaneous:

[ ] Suspension of action of the above-identified application is requested under 37 C.F.R. § 1.103(c) for a period of __ months.

The filing fee is calculated below:

	Claims as Amended		Previously Paid For		Extra Claims Present		Rate		Fee Totals
RCE Fee 1.17(e):							$810.00	=	$810.00
Total Claims:	18	-	21	=	0	x	$52.00	=	$0.00
Independents	2	-	4	=	0	x	$220.00	=	$0.00
First presentation of any Multiple Dependent Claims:						+	$390.00	=	$0.00
CLAIMS FEE TOTAL:								=	$810.00

[ ] Applicant hereby petitions for an extension of time under 37 C.F.R. §1.136(a) for the total number of months checked below:

[ ]	Extension for response filed within the first month:	$130.00	0	$0.00
[ ]	Extension for response filed within the second month:	$490.00		$0.00
[ ]	Extension for response filed within the third month:	$1,110.00		$0.00
[ ]	Extension for response filed within the fourth month:	$1,730.00		$0.00
[ ]	Extension for response filed within the fifth month:	$2,350.00		$0.00
	EXTENSION FEE SUBTOTAL:			$0.00
	EXTENSION FEE ALREADY PAID:		-	$0.00
	EXTENSION FEE TOTAL			$0.00
	CLAIMS AND EXTENSION FEE TOTAL:			$810.00
[X]	Small Entity Fees Apply (subtract ½ of above):			$405.00
[ ]	Suspension of action requested under 37 C.F.R. § 1.103(c)			$0.00
	TOTAL FEE:			$405.00

The above-identified fees of $405.00 are being paid by credit card via EFS-Web.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by the credit card payment instructions in EFS-Web being incorrect or absent, resulting in a rejected or incorrect credit card transaction, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

Please direct all correspondence to the undersigned attorney or agent at the address indicated below.

Respectfully submitted,

Date November 13, 2009

By _____

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Xiaoping REN *et al.*

Title: **SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME**

Appl. No.: 10/491,134

Filing Date: 05/06/2004

Examiner: Muhammad S. Siddiquee

Art Unit: 1795

Confirmation Number: 7003

AMENDMENT AND REPLY UNDER 37 CFR § 1.114

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

Sir:

This communication is responsive to the Final Office Action dated August 14, 2009, concerning the above-referenced patent application. This communication is being filed concurrently with a Request for Continued Examination (RCE).

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this document.

Remarks/Arguments begin on page 6 of this document.

AMENDMENTS TO THE CLAIMS

This listing replace all prior versions and listings of claims in the application.

Listing of Claims

1. (Currently Amended) A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that the charge cut-off voltage of the ~~single cell~~ secondary lithium ion cell or battery is greater than 4.2 V but less than 5.8 V; and [[the]] a ratio of positive electrode material to negative electrode material of the ~~single cell~~ secondary lithium ion cell or battery is from 1:1.0 to 1:2.5, as calculated by [[the]] a specific capacity with [[the]] a charge voltage limited to 4.2 V.

2. (Currently Amended) A method according to claim 1, characterized in that the charge cut-off voltage of the ~~single cell~~ secondary lithium ion cell or battery is within a range from 4.3 V to 5.2 V.

3. (Currently Amended) A method according to claim 1, characterized in that the charge cut-off voltage of the ~~single cell~~ secondary lithium ion cell or battery is within a range from 4.3 V to 4.8 V.

4. (Currently Amended) A method according to claim 1, characterized in that the ratio of positive electrode material to negative electrode material of the ~~single cell~~ secondary lithium ion cell or battery is from 1:1.15 to 1:2.5.

5. (Currently Amended) A secondary lithium ion cell or battery, ~~comprising:~~ characterized in that the secondary lithium ion cell or battery has a charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and a ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.0 to 1:2.5, as calculated by a theoretic capacity with a charge cut-off voltage set at 4.2 V.

~~a positive electrode material;~~

~~a negative electrode material;~~

~~an electrolyte; and~~

~~a protection circuit,~~

~~wherein the protection circuit is configured such that a charge cut-off voltage is greater than 4.2V and less than 5.8V, and~~

~~wherein a ratio of positive electrode material to negative electrode material is between 1:1.0 to 1:1.25 when capacities of the positive electrode material and the negative electrode material are calculated with a charge cut-off voltage set at 4.2V.~~

6. (Currently Amended) A secondary lithium ion cell or battery according to claim 5, characterized in that the secondary lithium ion cell or battery has a charge cut-off voltage within a range from 4.3 V to 5.2 V ~~wherein the protection circuit is configured such that a charge cut-off voltage is within a range from 4.3 V to 5.2 V~~.

7. (Currently Amended) A secondary lithium ion cell or battery according to claim 5, characterized in that the secondary lithium ion cell or battery has a charge cut-off voltage within a range from 4.3 V to 4.8. V ~~wherein the protection circuit is configured such that a charge cut-off voltage is within a range from 4.3 V to 4.8. V~~.

8. (Currently Amended) A secondary lithium ion cell or battery according to claim 5, characterized in that the ratio of positive electrode material to negative electrode material of the secondary lithium ion cell or battery is from 1:1.15 to 1:2.5.

9. (Currently Amended) A secondary lithium ion cell or battery according to claim 5, characterized in that the secondary lithium ion cell or battery has a first overcharging protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V ~~wherein the protection circuit is configured to have a first overcharging protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V~~.

10. (Currently Amended) A secondary lithium ion cell or battery according to claim 9, characterized in that the secondary lithium ion cell or battery has a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V ~~wherein the protection circuit is configured to have a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V~~.

11.-17. (Cancelled)

18. (Currently Amended) A secondary lithium ion cell or battery according to claim 5, wherein the secondary lithium ion cell or battery maintains at least 75% of capacity after 400 cycles.

19. (Currently Amended) A secondary lithium ion cell or battery according to claim 5, wherein the secondary lithium ion cell or battery maintains at least 75.83% of capacity after 400 cycles.

20. (Currently Amended) A secondary lithium ion cell or battery according to claim 5, wherein the secondary lithium ion cell or battery maintains at least 80% of capacity after 400 cycles.

21. (Currently Amended) A secondary lithium ion cell or battery according to claim 5, wherein the secondary lithium ion cell or battery maintains at least 80.72% of capacity after 400 cycles.

22. (New) A method according to claim 1, wherein the secondary lithium ion cell or battery maintains at least 75% of capacity after 400 cycles.

23. (New) A method according to claim 1, wherein the secondary lithium ion cell or battery maintains at least 75.83% of capacity after 400 cycles.

24. (New) A method according to claim 1, wherein the secondary lithium ion cell or battery maintains at least 80% of capacity after 400 cycles.

25. (New) A method according to claim 1, wherein the secondary lithium ion cell or battery maintains at least 80.72% of capacity after 400.

REMARKS

Applicant requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow. At the time of the present action, claims 1-21 were pending, with non-elected claims 11-17 withdrawn. Claims 1-10 and 18-21 are revised here, and claims 22-25 added. Claims 11-17 are cancelled. Thus, claims 1-10 and 18-25 are pending for examination.

Applicant would thank SPE Ryan and Examiner Siddiquee for taking the time on September 2, 2009, to discuss this application with applicant's representatives. Applicant acknowledges receipt of a related "Interview Summary," dated September 4, 2009, and provides the following commentary in response.

According to the Interview Summary, "it was concluded that claims 5-10 and 18-21 were not examined in the current amended form because these claims were directed to non-elected subject matter." Applicant reiterates that it does not believe this conclusion to be reasonable. Nevertheless, Applicant has amended the claims in the manner suggested by SPE Ryan and Examiner Siddiquee, in order that each of these claims is considered.

In particular, applicant has amended claims 5-10 in a manner substantially similar to their original form (with only minor amendments were made for potential antecedent issues). In addition, applicant has amended claims 18-21 in a corresponding manner.

Having thus complied with suggestion proffered during the interview, Applicant requests substantive examination of claims 5-10 and 18-21. Still, should Examiner Siddiquee determine for any reason that one or more of claims 1-10 and 18-25 will not be examined, Applicant expressly requests that the examiner contact the undersigned before issuing another action.

There is a statement in the Interview Summary that the "combination of the prior art would have been obvious because it has been held that a particular known technique was

recognized as part of the ordinary capabilities of one skilled in the art and would have been obvious because the substitution of one known element for another would have yielded predictable results to one of ordinary skill in the art at the time of invention." (Emphasis added.) In this regard, applicant notes that claims 1-4 were rejected over U.S. patent No. 5,260,148 (Idota) in view of U.S. patent No. 5,487,960 (Tanaka), and alternatively over Idota in view of U.S. patent No. 6,558,848 (Kobayashi).

Applicant respectfully disagrees with the foregoing statement, which is based on the premise that combining Idota with Tanaka or Kobayashi would have yielded "predictable results." The result of the claimed invention, however, is not what would have been predictable, in view of the art exemplified by these publications.

To the contrary, numerous documents discussed in detail below demonstrate that the result achieved with the claimed invention ***contravened*** the understanding and expectations of the prior art and, hence, would have been wholly ***surprising*** to one of ordinary skill. Indeed, the present inventors themselves "*unexpectedly* found that the efficacy of electrode active material is greatly increased by increasing the charge cut-off voltage and property [sic] adjusting the ratio of positive electrode material to negative electrode material of single lithium ion cell." Published application at paragraph 0012 (emphasis added).

Apropos of this point, MPEP § 2164.03 states in relevant part that:

> The "predictability or lack thereof" in the art refers to the ability of one skilled in the art to extrapolate the disclosed or known results to the claimed invention. If one skilled in the art can readily anticipate the effect of a change within the subject matter to which the claimed invention pertains, then there is predictability in the art. On the other hand, if one skilled in the art cannot readily anticipate the effect of a change within the subject matter to which that claimed invention pertains, then there is lack of predictability in the art. Accordingly, what is known in the art provides evidence as to the question of predictability.

(Emphasis added.) Thus, "predictability" pertains only if one skilled in the art could have "readily anticipated" the effect the change.

In the present instance there was no one, including the inventors themselves, who could have "readily anticipated" that the claimed charge cut-off voltage range, in combination with the claimed ratio of positive electrode material to negative electrode material, results in a secondary lithium ion battery free of poor recyclability and electrolyte breakdown. This point is evidenced by the following publications of record, each of which indicates that the anticipated result of the claimed invention would have been exactly the opposite, *i.e.*, a battery with poor recyclability and/or significant electrolyte breakdown:[1]

JP 2001-176559[2]

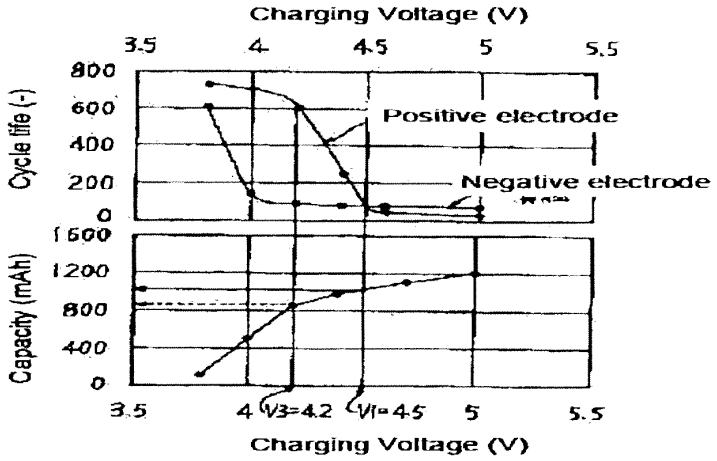
Figure 1 of JP 2001-176559 (reproduced below) shows that the cycle property of a cell drastically decreases when the charging voltage increases beyond 4.2V. Accordingly, one of ordinary skill at the time of invention would have "readily anticipated" that the claimed invention would have yielded a cell with poor recyclability. The skilled artisan would not have predicted that the resulting cell would have high capacity after a high number of cycles. See claims 18-25.

[1] Some of the provided documents were published before applicant's effective filing date of September 28, 2001, based on Canadian application No. 011416157), while others were published after that date. Accordingly, these publications are demonstrative of the state of the relevant art, before *and* after the date to the present invention, which supports applicant's position on "predictability" (or, more precisely, the lack of it) here.

[2] JP 2001-176559, Yamamoto et al., December 15, 1999 (filing date).

Fig. 1

Graph showing a relationship between cycle life and charging voltage



Zou Publication[3]

Zou was published after the effective filing date of the present application. This publication counsels that "structural changes" and "inferior capacities" occur when cells are charged at higher voltages. Accordingly, one of ordinary skill in the art at the time of invention would have "readily anticipated" that the claimed invention would have produced a cell with inferior capacity and structural changes. The skilled artisan would not have predicted that the resulting cell would have high capacity after a high number of cycles, as is the case with the claimed invention.

> In view of the advantages associated with LiCoO2, the maximum attainable practical capacity is only around 137 mA·h/g when cycled in the voltage range 3-4.25 V, although the theoretical capacity is as high as 273.8 mA·h/g. Therefore, to obtain higher capacities, one has to charge

[3] Zou *et al.*, "Synthesis of High-Voltage (4.5V) Cycling Doped $LiCoO_2$ for Use in Lithium Rechargeable Cells," *Chemistry of Materials*, Vol. 15, No. 25 (2003).

> the cells to high voltages (4.5 V). However, such attempts failed to produce stable LiCoO2 due to structural changes taking place during cycling. Attempts to improve the cycleability beyond 4.25 V have been reported by some authors by doping with either Mg or Al. However, such results only report inferior capacities. Theoretical studies suggest that doping of LiCoO2 with a transition metal ion leads to an increase in capacity whereas on the other hand non-transitionmetal ion doping leads to an increase in voltage at the expense of capacity. To overcome the cycling problems at high voltages, very recently, Cho et al. demonstrated that coating of LiCoO2 with ceramic materials such as Al2O3 and ZrO2 is the only available option for obtaining stable capacities when cycled up to 4.5 V and this was confirmed by Dahn et al. However, apart from these studies to the best of our knowledge there is no report on the stable cycling of doped LiCoO2 at high voltages (4.5 V).

(Citations omitted; emphasis added.)

Mizushima publication[4]

Mizushima advises that "a risk of electrolyte breakdown" is observed when "the measured open-cell voltages were found to be in excess of 4V" (page 786). Thus, one of ordinary skill in the art at the time of invention would have "readily anticipated" that the claimed invention would produce a cell with electrolyte breakdown. The skilled artisan would not have predicted that the resulting cell would have the superior performance attained by the claimed invention.

Pistoia publication[5]

Postoia counsels that the structure of lithium cobalt oxide changes with the charge voltage, and that the coexistence of monoclinic phase and hexagonal phase will appear when the charge voltage is over a certain value, spoiling the recycle property of the cell (*See* pages 37, 38,

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[4] Mizushima *et al*, "A New Cathode Material for Batteries of High Energy Density," *Material Research Bulletin*, 783-89 (1980).

[5] Posita *et al.*, "Synthesis of Mn spinels from different polymorphs of MnO_2," *Journal of Power Sources*, 37-43 (1995).

and 40 of Postoia). Therefore, one of ordinary skill in the art at the time of invention would have "readily anticipated" that the claimed invention would have produced a cell with a spoiled recycle property. The skilled artisan would not have predicted that the resulting cell would have high capacity after a high number of cycles. Compare claims 18-25.

In view of ample evidence discussed above, applicant submits that the PTO cannot reasonably assert that the result of the claimed invention was "predictable." Moreover, the PTO has provided no evidence or reasoning to substantiate predictability; hence, applicant's position and related showing stand unrebutted on the record. Accordingly, applicant respectfully requests withdrawal of the rejection based on these speculative grounds.

In a similar vein, applicant notes that the previous Office Action did not address in substance the arguments advanced in applicant's last response. Accordingly, should the examiner be inclined to maintain the rejection, then he is asked to discuss each of these arguments, as such, along with the arguments presented above.[6]

Even if it is assumed, *arguendo*, that the references somehow are properly combinable under Section 103, the fact would remain that modifying the battery of Idota to include a charge cut-off voltage above 4.2V would result in a battery with decreased capacity and/or cycle life, in contrast to applicant's claimed invention. Such a battery also would not be a "secondary" lithium ion battery, as the present claims require. Put another way, even if the skilled artisan had ignored conventional wisdom and combined Idota with Tanaka or Kobayashi, the expected result would have been a lithium ion battery with very poor cycleability, *e.g.*, a capacity of 50% after the cell is depleted and recharged. Those in the battery field would not categorize such a battery as a "secondary" type cell, since that appellation denotes a battery that can be recharged to capacities relatively close to the original capacity. The battery obtained by combining Idota with Tanaka or

[6] Section 707.07(f) of the MPEP states that, "[w]here the applicant traverses any rejection, the examiner should, if he or she repeats the rejection, take note of the applicant's argument and answer the substance of it." (Emphasis added).

Kobayashi would meet neither these capacity requirements upon recharge nor the requirement prescribed by the present claims.

Additionally, even if combinability of the references were assumed, then modifying the battery of Idota to include a charging cut off voltage of 3.5V to 5V, as taught in Tanaka, still would result in a battery that could handle only transient or temporary conditions caused by abrupt temperature rises. See Tanaka, for example, in the Abstract and at column 2, lines 39-43. By contrast, a battery of the claimed invention can sustain normal operation under a charge cut-off voltage greater than 4.2V. This result, documented in examples 1-28 of the present application, likewise would not have been expected in view of Idota and Tanaka, further vindicating claim patentability.

Furthermore, and with respect to dependent claims 18-25, Applicant notes that these claims recite that the secondary lithium ion battery maintains a specific capacity after 400 cycles. As discussed above, the proposed combination of references, even if proper, would not have produced a "secondary" type battery, because the capacity and cycleability generally associated with a secondary-type battery would not be present. Certainly, the proposed combination of references would not have yielded a lithium ion battery that maintains a capacity above 75% after 400 cycles. Everything in the provided documents supports this point, while nothing in the cited references would have prompted one of ordinary skill to conclude differently. In addition to the reasons presented above, therefore, claims 18-25 also are patentable for this reason.

CONCLUSION

Applicant submits that this application is in condition for allowance, and an early indication to this effect is requested. Examiner Siddiquee is invited to contact the undersigned directly, should he feel that any other point requires consideration.

The Commissioner is hereby authorized to charge any additional fees, which may be required under 37 C.F.R. §§ 1.16-1.17, and to credit any overpayment to Deposit Account

No. 19-0741. Should no proper payment accompany this response, then the Commissioner is authorized to charge the unpaid amount to the same deposit account. If any extension is needed for timely acceptance of submitted papers, then applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of the relevant fee(s) to the deposit account.

Respectfully submitted,

Date November 13, 2009

By _____

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

Atty. Dkt. No. 042787-0106

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Xiaoping REN et al.
Title:	SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME
Appl. No.:	10/491,134
International Filing Date:	09/28/2002
371(c) Date:	05/06/2004
Examiner:	Muhammad S. Siddiquee
Art Unit:	1795
Confirmation Number:	7003

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR §1.56

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

Sir:

Submitted herewith on Form PTO/SB/08 is a listing of documents known to Applicants in order to comply with Applicants' duty of disclosure pursuant to 37 CFR §1.56.

A copy of each non-U.S. patent document and each non-patent document is being submitted to comply with the provisions of 37 CFR §1.97 and §1.98.

The submission of any document herewith, which is not a statutory bar, is not intended as an admission that such document constitutes prior art against the claims of the present application or that such document is considered material to patentability as defined in 37 CFR §1.56(b). Applicants do not waive any rights to take any action which would be appropriate to antedate or otherwise remove as a competent reference any document which is determined to be a *prima facie* art reference against the claims of the present application.

TIMING OF THE DISCLOSURE

The listed documents are being submitted in compliance with 37 CFR §1.97(b), Before the mailing of a first Office action after the filing of a Request for Continued Examination under §1.114.

RELEVANCE OF EACH DOCUMENT

Applicants respectfully request that each listed document be considered by the Examiner and be made of record in the present application and that an initialed copy of Form PTO/SB/08 be returned in accordance with MPEP §609.

Although Applicant believes that no fee is required, the Commissioner is hereby authorized to charge any additional fees which may be due to Deposit Account No. 19-0741.

Respectfully submitted,

Date November 13, 2009

By

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Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

PTO/SB/08 (09-06)
Approved for use through 03/31/2007. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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Substitute for form 1449/PTO				*Complete if Known*	
SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT BY APPLICANT				**Application Number**	10/491,134
Date Submitted: November 13, 2009				**Filing Date**	05/06/2004
				First Named Inventor	Xiaoping REN
(use as many sheets as necessary)				Art Unit	1795
				Examiner Name	Muhammad S. Siddiquee
Sheet	1	of	1	Attorney Docket Number	042787-0106

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

UNPUBLISHED U.S. PATENT APPLICATION DOCUMENTS

Examiner Initials*	Cite No.[1]	U.S. Patent Application Document Serial Number-Kind Code[2] (*if known*)	Filing Date of Cited Document MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (*if known*)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Documents	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]
		Office Action dated June 9, 2009, in corresponding Japanese Application No. 2003-533374, English Translation 3 pages	
		Patent Abstracts of Japan Publication No. 2001-176559 dated June 29, 2001, *ABSTRACT*	
		Patent Abstracts of Japan Publication No. 09-259928 dated October 3, 1977, *ABSTRACT*	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. 3 Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). 4 For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. 5 Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. 6 Applicant is to place a check mark here if English language Translation is attached. 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 2 hours 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, 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.**

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WASH_6580623.1

Electronic Patent Application Fee Transmittal	
Application Number:	10491134
Filing Date:	06-May-2004
Title of Invention:	Secondary lithium ion cell or battery, and protecting circuit, electronic device, and charging device of the same
First Named Inventor/Applicant Name:	Xiaoping Ren
Filer:	Stephen A. Bent/Linda Novak
Attorney Docket Number:	042787-0106
Filed as Small Entity	

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Request for continued examination	2801	1	405	405
		Total in USD ($)		**405**

Electronic Acknowledgement Receipt	
EFS ID:	6451726
Application Number:	10491134
International Application Number:	
Confirmation Number:	7003
Title of Invention:	Secondary lithium ion cell or battery, and protecting circuit, electronic device, and charging device of the same
First Named Inventor/Applicant Name:	Xiaoping Ren
Customer Number:	22428
Filer:	Stephen A. Bent/Linda Novak
Filer Authorized By:	Stephen A. Bent
Attorney Docket Number:	042787-0106
Receipt Date:	13-NOV-2009
Filing Date:	06-MAY-2004
Time Stamp:	16:22:38
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$405
RAM confirmation Number	2583
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1		RCEwAmendmentandIDS.pdf	471956 6efa5375ff5e899487a729dd6bb8a625767bf5bf	yes	28

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Request for Continued Examination (RCE)	1	4
	Amendment Submitted/Entered with Filing of CPA/RCE	5	5
	Claims	6	9
	Applicant Arguments/Remarks Made in an Amendment	10	17
	Information Disclosure Statement (IDS) Filed (SB/08)	18	20
	NPL Documents	21	23
	NPL Documents	24	26
	NPL Documents	27	28

Warnings:					
Information:					
2	Fee Worksheet (PTO-875)	fee-info.pdf	30370 5507d4543e6250fc6fbb0b5d7b7393efacbae846	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	502326	

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If a new application is being filed and the application includes the necessary components for a 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.

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PTO/SB/06 (07-06)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 10/491,134	Filing Date 05/06/2004	☐ To be Mailed

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	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 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			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	11/13/2009	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $26 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $110 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

AMENDMENT		(Column 1)		(Column 2)	(Column 3)	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA					
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	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 number found in the appropriate box in column 1.

Legal Instrument Examiner:
/ANNIE c. SINGLETON/

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.**

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Siddiquee, Muhammad

From: Haq, Mohammad A. (Aamir) [MHaq@foley.com]
Sent: Tuesday, September 01, 2009 3:00 PM
To: Siddiquee, Muhammad
Subject: Application No. 10/491,134 (Interview discussion topics)

SPE Ryan, Examiner Siddiquee -

Per your request, we would like to discuss the following two issues in the telephone interview at 1:00pm EST tomorrow:

1. The obligation to evaluate any evidence, including published documents, that are proffered to substantiate the state of the relevant art.

2. Issues surrounding claims 5-10 and 18-21 not being examined under the assertion that these claims were directed to non-elected subject matter.

We look forward to speaking with both of you on these matters. In the meantime, if you have any questions, please do not hesitate contacting us.

Best regards,
Aamir Haq

Aamir Haq
Foley & Lardner LLP
3000 K Street, N.W., Suite 500
Washington, D.C. 20007
202.672.5394
mhaq@foley.com

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/491,134	05/06/2004	Xiaoping Ren	042787-0106	7003

22428 7590 09/04/2009
FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

EXAMINER	
SIDDIQUEE, MUHAMMAD S	
ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
09/04/2009	PAPER

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.

Interview Summary	Application No.	Applicant(s)	
	10/491,134	REN ET AL.	
	Examiner	Art Unit	
	MUHAMMAD SIDDIQUEE	1795	

All participants (applicant, applicant's representative, PTO personnel):

(1) *MUHAMMAD SIDDIQUEE*. (3)*Mohammad Haq*.

(2) *Patrick Ryan*. (4)_____.

Date of Interview: *02 September 2009*.

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal [copy given to: 1)☐ applicant 2)☒ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____.

Claim(s) discussed: *1-10 and 18-21*.

Identification of prior art discussed: *US 5,487,960* .

Agreement with respect to the claims f)☐ was reached. g)☒ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *See Continuation Sheet*.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN A NON-EXTENDABLE PERIOD OF THE LONGER OF ONE MONTH OR THIRTY DAYS FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

/Muhammad Siddiquee/ Examiner, Art Unit 1795	/PATRICK RYAN/ Supervisory Patent Examiner, Art Unit 1795

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews
Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
   (The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

Continuation of Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments:

It was concluded that claims 5-10 and 18-21 were not examined in the current amended form because these claims were directed to non-elected subject matter.

Prior art references were discussed with respect to aplicant's proposed agenda (see attached) and also the SPE discissed the matter with several other mangers and concluded that combination of the prior art would have been obvious because it has been held that a particular known technique was recognized as part of the ordinary capabilities of one skilled in the art and would have been obvious because the substitution of one known element for another would have yielded predictable results to one of ordinary skill in the art at the time of the invention. .

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/491,134	05/06/2004	Xiaoping Ren	042787-0106	7003

22428 7590 08/14/2009

FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

EXAMINER	
SIDDIQUEE, MUHAMMAD S	
ART UNIT	PAPER NUMBER
1795	
MAIL DATE	DELIVERY MODE
08/14/2009	PAPER

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.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)	
	10/491,134	REN ET AL.	
	Examiner	Art Unit	
	MUHAMMAD SIDDIQUEE	1795	

-- 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* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *15 May 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ 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

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) *11-17* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4* is/are rejected.

7)☒ Claim(s) *5-10 and 18-21* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

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

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Applicant's amendment filed on 5/15/2009 was received. Claims 1, 5-10 are amended and claims 11-17 are withdrawn and claims 18-21 are added.

Response to Amendment

The amendment filed on 5/15/2009 is not fully responsive because in the restriction/election requirements, the subject matter of a protection circuit was withdrawn, however, claim 5 is amended with a protection circuit and new claims 18-21 depends from claim 5. Therefore, claims 5-10 and 18-21 are not examined.

Response to Arguments

1. Applicant's arguments filed 5/15/2009 have been fully considered but they are not persuasive. In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Tanaka reference teaches that having a charging cut-off voltage of 3.5 to 5 volts improves the safety of the battery and therefore, it would have been obvious for a skilled artisan to adopt this teachings. Applicant's arguments of "accepted belief"/"conventional wisdom" that secondary lithium ion battery could not efficiently be charged above 4.2V

without an adverse impact do not weigh much where teachings of having a charging cut-off voltage of 3.5 to 5 volts improving the safety of the battery is present in the prior art.

2. Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Idota (US 5,260,148) in view of Tanaka (5,487,960).

Regarding claims 1-4, Idota discloses a lithium secondary battery comprising an anode and a cathode where the ratio of the equivalent amount of the anode (negative electrode) active material to that of the cathode (positive electrode) active material be larger than 1 (i.e., the amount of the anode active material is more than equivalent to the cathode active material). The ratio thereof is more preferably from 1.1 to 5, most preferably from 1.1 to 3.5. [column 3, lines 14-19]. Idota does not specifically disclose battery is capable of being charged to between 4.2 volts to 5.8 volts. However, Tanaka discloses a nonaqueous secondary battery having improved safety in case of abrupt temperature rise, which is capable of intercalating and deintercalating a lithium ion and has a charging cut-off voltage of 3.5 to 5 V [column 1, lines 39-43; column 3, lines 21-49]. Improving capacity, average operating voltage and specific energy of a secondary lithium ion battery with known method and advantages in the prior art is within the reach of an ordinary skilled artisan. Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to utilize cut-off voltage as taught by Tanaka in the battery of Idota in order to have a safer and thereby an efficient battery.

3. Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Idota (US 5,260,148) in view of Kobayashi et al (US 6,558,848 B1).

Regarding claims 1-4, Idota discloses a lithium secondary battery comprising an anode and a cathode where the ratio of the equivalent amount of the anode (negative electrode) active material to that of the cathode (positive electrode) active material be larger than 1 (i.e., the amount of the anode active material is more than equivalent to the cathode active material). The ratio thereof is more preferably from 1.1 to 5, most preferably from 1.1 to 3.5. [column 3, lines 14-19]. Idota does not specifically disclose battery is capable of being charged to between 4.2 volts to 5.8 volts. However, Kobayashi discloses secondary battery where in the case of lithium secondary cells, the charge cut-off voltage was set at 4.5V and discharge cut-off voltage at 4.5V [column 20, lines 24-31]. Overcharging protection release voltage is inherent in the battery. Improving capacity, average operating voltage and specific energy of a secondary lithium ion battery with known method and advantages in the prior art is within the reach of an ordinary skilled artisan. Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to utilize cut-off voltage as taught by Tanaka in the battery of Idota in order to have a safer and thereby an efficient battery.

Conclusion

4. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MUHAMMAD SIDDIQUEE whose telephone number is (571) 270-3719. The examiner can normally be reached on Monday-Thursday, 7:30 am to 4:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Muhammad Siddiquee/
Examiner, Art Unit 1795
/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1795

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/21/2008	07/12/2008	01/12/2009	08/11/2009					
	1	÷	✓	✓	✓					
	2	÷	✓	✓	✓					
	3	÷	✓	✓	✓					
	4	÷	✓	✓	✓					
	5	÷	✓	✓	O					
	6	÷	✓	✓	O					
	7	÷	✓	✓	O					
	8	÷	✓	✓	O					
	9	÷	✓	✓	O					
	10	÷	✓	✓	O					
	11	÷	N	N	N					
	12	÷	N	N	N					
	13	÷	N	N	N					
	14	÷	N	N	N					
	15	÷	N	N	N					
	16	÷	N	N	N					
	17	÷	N	N	N					
	18				O					
	19				O					
	20				O					
	21				O					

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

SEARCHED			
Class	Subclass	Date	Examiner
429	60, 231.95	7/11/2008	MSS

SEARCH NOTES		
Search Notes	Date	Examiner
Consulted with Gregg Cantelmo in Art unit 1795	7/11/2008	MSS
Searched for Inventor in EAST and PALM (assignee info is not avaiable in PALM)	7/11/2008	MSS
Searched USPAT, US-PGPUB, EPO, JPO, DERWENT	7/11/2008	MSS
Class 429/60, 231.95 was limited by text, see EAST search history.	7/11/2008	MSS
Text Searched, see EAST search results.	1/9/2009	MSS
Consulted with Jonathan Crepeau in Art unit 1795	1/9/2009	MSS
Consulted with Jonathan Crepeau in Art unit 1795	8/11/2009	MSS

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

/MUHAMMAD SIDDIQUEE/ Examiner.Art Unit 1795	

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Xiaoping REN *et al.*

Title: **SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME**

Appl. No.: 10/491,134

371(c) Date: 05/06/2004

Examiner: Muhammad S. Siddiquee

Art Unit: 1795

Confirmation Number: 7003

AMENDMENT AND REPLY UNDER 37 CFR § 1.111

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

Sir:

This communication is responsive to the Non-Final Office Action dated January 16, 2009, concerning the above-referenced patent application.

Applicant has enclosed with this amendment a Petition for Extension of Time to make this response timely.

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this document.

Remarks/Arguments begin on page 6 of this document.

AMENDMENTS TO THE CLAIMS

This listing replaces all prior versions and listings of claims in the application.

Listing of Claims

1. (Currently Amended) A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that the charge cut-off voltage of the single cell is greater than 4.2 V but less than 5.8 V; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, [[5,]] as calculated by the specific capacity with the charge voltage limited to 4.2 V.

2. (Previously Presented) A method according to claim 1, characterized in that the charge cut-off voltage of the single cell is within a range from 4.3 V to 5.2 V.

3. (Previously Presented) A method according to claim 1, characterized in that the charge cut-off voltage of the single cell is within a range from 4.3 V to 4.8 V.

4. (Previously Presented) A method according to claim 1, characterized in that the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.15 to 1:2.5.

5. (Currently Amended) A secondary lithium ion ~~cell or~~ battery, ~~characterized in that the single secondary lithium ion cell has a charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, as calculated by the theoretic capacity with the charge cut-off voltage set at 4.2 V~~ comprising:

a positive electrode material;

a negative electrode material;

an electrolyte; and

a protection circuit,

wherein the protection circuit is configured such that a charge cut-off voltage is greater than 4.2V and less than 5.8V, and

wherein a ratio of positive electrode material to negative electrode material is between 1:1.0 to 1:1.25 when capacities of the positive electrode material and the negative electrode material are calculated with a charge cut-off voltage set at 4.2V.

6. (Currently Amended) A secondary lithium ion ~~cell or~~ battery according to claim 5, ~~characterized in that the single secondary lithium ion cell has a charge cut-off voltage~~ wherein the protection circuit is configured such that a charge cut-off voltage is within a range from 4.3 V to 5.2 V.

7. (Currently Amended) A secondary lithium ion ~~cell or~~ battery according to claim 5, ~~characterized in that the single secondary lithium ion cell has a charge cut-off voltage~~ wherein the protection circuit is configured such that a charge cut-off voltage is within a range from 4.3 V to 4.8. V.

8. (Currently Amended) A secondary lithium ion ~~cell or~~ battery according to claim 5, characterized in that the ratio of positive electrode material to negative electrode material ~~of the single cell~~ is from 1:1.15 to 1:2.5.

9. (Currently Amended) A secondary lithium ion ~~cell or~~ battery according to claim 5, ~~characterized in that the single lithium ion cell has~~ wherein the protection circuit is configured to have a first overcharging protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V.

10. (Currently Amended) A secondary lithium ion ~~cell or~~ battery according to claim 9, ~~characterized in that the single lithium ion cell has~~ wherein the protection circuit is configured to have a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

11. (Withdrawn) A protecting circuit for the secondary lithium ion cell or battery according to claim 5, characterized in that the single lithium ion cell of said protecting circuit has a first overcharge protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V.

12. (Withdrawn) A protecting circuit according to claim 11, characterized in that the single lithium ion cell of said protecting circuit has a first overcharge protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

13. (Withdrawn) An electronic device using a secondary lithium ion cell or battery as energy source, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge protection release voltage of greater than 4.15 V.

14. (Withdrawn) An electronic device according to claim 13, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

15. (Withdrawn) A charging device for a secondary lithium ion cell or battery, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range of greater than 4.3 V but less than 5.8 V.

16. (Withdrawn) A charging device according to claim 15, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range from 4.3 V to 5.2 V.

17. (Withdrawn) A charging device according to claim 15, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range from 4.3 V to 4.8 V.

18. (New) A secondary lithium ion battery according to claim 5, wherein the secondary lithium ion battery maintains at least 75% of capacity after 400 cycles.

19. (New A secondary lithium ion battery according to claim 5, wherein the secondary lithium ion battery maintains at least 75.83% of capacity after 400 cycles.

20. (New) A secondary lithium ion battery according to claim 5, wherein the secondary lithium ion battery maintains at least 80% of capacity after 400 cycles.

21. (New) A secondary lithium ion battery according to claim 5, wherein the secondary lithium ion battery maintains at least 80.72% of capacity after 400 cycles.

REMARKS

Applicant requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow. At the time of the present action, claims 1-17 were pending, with non-elected claims 11-17 withdrawn. Claims 1 and 5-10 are revised here, and claims 18-21 are added.[1]. Thus, claims 1-10 and 18-21 are pending for examination.

I. Claim Objection

On page 2 of the Office Action, claim 1 was objected to for a typographical error. In response to this objection, Applicant has amended claim 1 to correct this typographical error, and therefore respectfully requests withdrawal of this objection.

II. 35 U.S.C. § 103(a)

On page 3 of the Office Action, claims 1-10 were rejected over U.S. Patent No. 5,260,148 (Idota) in view of U.S. Patent No. 5,487,960 (Tanaka). On page 4, claims 1-10 were rejected over Idota in view of U.S. 6,558,848 (Kobayashi). Applicant respectfully traverses these rejection for the reasons set forth below.

A. Background

As discussed in the background section of the present application, 4.2V is the well accepted charge cut-off voltage for secondary lithium ion batteries. Although using a charge cut-off voltage greater than 4.2V results in an improved capacity and improved operating voltage, negative side effects such as structural changes in the positive and negative electrode materials, decomposing of the electrolyte, and reduced recycle properties have kept the battery industry from using a charge cut-off voltage greater than 4.2V. This point is well-established by the documents cited and summarized in the background section of the present application.

[1] Applicant notes that a plurality of amendments have been made for formal and stylistic purposes, and Applicant does not intend to does not intend to narrow the scope of these claims. Nor is it intended to surrender any claim scope with regard to the Doctrine of Equivalents.

In contravention of common opinion in the art, Applicant discovered an approach for raising the cut-off voltage above 4.2V without substantially changing the electrode materials, and without substantially decomposing the electrolyte. In a manner wholly unforeseen by the art, Applicant's novel methodology did not diminish the recycle property of the secondary lithium ion battery.

As claimed, the inventive methodology comprises (1) using a charge cut-off voltage between 4.2 V and 5.8 V, and (2) using a ratio of positive electrode material to negative electrode material that is between 1:1.0 and 1:2.5, as calculated by the specific capacity with the charge voltage limited to 4.2 V. Applying this specific ratio and specific voltage range, in accordance with the claimed invention, yields to a secondary lithium ion battery the properties of which, as noted above, would have been unexpected in view of the art of record. The patentability of the claims in question is not properly obviated by the applied references, therefore.

B. Claim Rejections

The Examiner rejected the claims based on combinations of Idota with Tanaka/Kobayashi, respectively. In each instance, the Examiner's stated position was that (i) Idota teaches the ratio aspect of the claimed invention and (ii) Tanaka/Kobayashi teaches the voltage aspect, and that the motivation underlying either combination was to "have a safer and thereby an efficient battery." In particular, the Examiner relied on a portion of Tanaka which mentioned "a charging cut-off voltage of 3.5V to 5V", and a portion of Kobayashi that mentioned a "charge cut-off voltage set at 4.5V." See page 4 of Office Action.

Given the context of Tanaka and Kobayashi, however, one of ordinary skill in the art would not consider these discussions to refute the accepted principle that a secondary lithium ion battery could not be efficiently charged above 4.2V, as evidenced at least by the documents cited in Applicant's specification. Therefore, and as discussed in further detail below, the asserted combinations do not render the claimed invention obvious, and do not change the accepted belief that secondary lithium ion battery could not efficiently be charged above 4.2V without an adverse impact.

Applicant respectfully submits that one of ordinary skill at the time of invention would have not have been motivated to combine Idota with Tanaka or Idota with Kobayashi because doing so would have deviated from contemporaneous understanding ("conventional wisdom") in the battery field. As discussed throughout the background section of the application, it was well-accepted heretofore that a lithium ion battery could not be charged above 4.2V without numerous adverse side effects. By way of evidence on point, the application invokes a Mizushima publication[2] (of record), which notes "a risk of electrolyte breakdown" observed when "the measured open-cell voltages were found to be in excess of 4V" (page 786). In a related vein, a Pistoia publication[3] (of record) counsels that the structure of lithium cobalt oxide changes with the charge voltage, and that the coexistence of monoclinic phase and hexagonal phase will appear when the charge voltage is over a certain value, spoiling the recycle property of the cell (pages 37, 38, and 40).

Thus, the record substantiates the fact that, prior to the time of invention, it was conventional wisdom that a battery should be charged only to 4.2V, and that anything greater would cause electrolyte breakdown, reduced recycle properties, and structural changes in the electrode materials. Indeed, this was the understanding in the art long after the effective filing date of the present application. This point is evidenced by a Zou publication (attached for the Examiner's convenience),[4] which states in the introduction portion of the document:

> In view of the advantages associated with LiCoO2, the maximum attainable practical capacity is only around 137 mA·h/g when cycled in the voltage range 3-4.25 V, although the theoretical capacity is as high as 273.8 mA·h/g. Therefore, to obtain higher capacities, one has to charge the cells to high voltages (4.5 V). However, such attempts failed to produce stable LiCoO2 due to structural changes taking place during cycling. Attempts to improve the cycleability beyond 4.25 V have been reported by some authors by doping with either Mg or Al. However, such results only report inferior capacities. Theoretical studies suggest that doping of LiCoO2 with

[2] Mizushima *et al*, A New Cathode Material for Batteries of High Energy Density, Material Research Bulletin, 783-789 (1980).

[3] Posita *et al.*, Synthesis of Mn spinels from different polymorphs of MnO_2, Journal of Power Sources, 37-43 (1995).

[4] Zou *et al.*, Synthesis of High-Voltage (4.5V) Cycling Doped $LiCoO_2$ for Use in Lithium Rechargeable Cells, Chemistry of Materials, Vol. 15, No. 25 (2003).

> a transition metal ion leads to an increase in capacity whereas on the other hand non-transitionmetal ion doping leads to an increase in voltage at the expense of capacity. To overcome the cycling problems at high voltages, very recently, Cho et al. demonstrated that coating of LiCoO2 with ceramic materials such as Al2O3 and ZrO2 is the only available option for obtaining stable capacities when cycled up to 4.5 V and this was confirmed by Dahn et al. However, apart from these studies to the best of our knowledge there is no report on the stable cycling of doped LiCoO2 at high voltages (4.5 V).

(Emphasis added.) As of December of 2003, therefore, well after Applicant's effective filing date, a strong desire persisted for increasing the charge voltage level to increase the capacity of a secondary lithium ion battery. Yet, all attempts had failed due to stability issues, decreased cycleability, and/or decreased capacity.

In view of the foregoing, Applicant submits that it was accepted in the battery field, before and after the effective filing date of the present application, that charging a secondary lithium ion battery above 4.2V would cause electrolyte breakdown, reduced recycle properties, and/or structural changes in the electrode materials. Accordingly, the skilled artisan would not have combined Idota with Tanaka or with Kobayashi because of an expectation, in keeping with conventional wisdom of the day, that the resulting battery would display inferior capacity and/or cycleability.

The U.S. Supreme Court addressed a similar situation in *United States v. Adams.*[5] There the Court held that:

> ...the Adams battery was also nonobvious. As we have seen, the operating characteristics of the Adams battery have been shown to have been unexpected and to have far surpassed then-existing wet batteries. Despite the fact that each of the elements of the Adams battery was well known in the prior art, to combine them as did Adams required that a person reasonably skilled in the prior art must ignore that (1) batteries which continued to operate on an open circuit and which heated in normal use were not practical; and (2) water-activated batteries were successful only when combined with electrolytes detrimental to the use of magnesium. These long-accepted factors, when taken together, would, we believe, deter any investigation into such a combination as is used by Adams. This is not to say that one who merely finds new uses for old inventions by shutting his

[5] *U.S. v. Adams*, 383 U.S. 39 (1966).

> eyes to their prior disadvantages thereby discovers a patentable innovation. We do say, however, that known disadvantages in old devices which would naturally discourage the search for new inventions may be taken into account in determining obviousness.

(Emphasis added.) By the same token, the present claims are non-obviousness in view of the references of record because the known disadvantages would have naturally discouraged one of ordinary skill in the art from combining the cited art in the manner posited by the Examiner.

These reasons are sufficient to warrant withdrawal of these rejections. Even were the references somehow deemed properly combinable under Section 103, moreover, the fact would remain that modifying the battery of Idota to include a charge cut-off voltage above 4.2V would result in a battery with decreased capacity and/or cycle life. Such a battery would not be a "secondary" lithium ion battery, as the present claims require.

Put another way, even if one of ordinary skill in the art had ignored conventional wisdom and combined Idota with Tanaka or Kobayashi, the hypothesized result would have been a lithium ion battery with very poor cycleability, e.g., a capacity of 50% after the cell is depleted and recharged. Those in the battery field would not categorize such a battery as a "secondary" type cell, since that appellation denotes a battery that can be recharged to capacities relatively close to the original capacity. The battery obtained by combining Idota with Tanaka or Kobayashi would meet neither these capacity requirements upon recharge nor the recited requirement in the present claims.

Third, even if combinability of the references were assumed, *arguendo*, then modifying the battery of Idota to include a charging cut off voltage of 3.5V to 5V, as disclosed in Tanaka, still would result in a battery that could handle only transient or temporary conditions caused by abrupt temperature rises. See Tanaka, for example, in the Abstract and at column 2, lines 39-43. By contrast, a battery of the claimed invention can sustain normal operation under a charge cut-off voltage greater than 4.2V. This result, documented in examples 1-28 of the present application, would not have been expected in view of Idota and Tanaka, further vindicating claim patentability.

Applicant respectfully submits, therefore, that independent claims 1 and 5 are patentable over the cited art. Reconsideration and withdrawal of these Section 103 rejections are requested.

III. New Claims 18-21

New claims 18-21 are supported throughout the application. For instance, see Examples 20, 22, and 27 of the original specification.

Each of the new claims recites that the secondary lithium ion battery maintains a specific capacity after 400 cycles. As discussed above, the proposed combination of references, even if proper, would not have produced a "secondary" type battery, because the capacity and cycleability generally associated with a secondary-type battery would not be present. Certainly, the proposed combination of references would not have yielded a lithium ion battery that maintains a capacity above 75% after 400 cycles. Everything in the provided documents supports this point, while nothing in the cited references would have prompted one of ordinary skill to conclude differently. In addition to the reasons presented above, therefore, claims 18-21 also are patentable for this reason.

CONCLUSION

Applicant submits that this application is in condition for allowance, and an early indication to this effect is requested. Examiner Siddiquee is invited to contact the undersigned directly, should he feel that any other point requires consideration.

Respectfully submitted,

Date May 15, 2009

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ATTACHMENT
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Communications

Synthesis of High-Voltage (4.5 V) Cycling Doped $LiCoO_2$ for Use in Lithium Rechargeable Cells

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Introduction. Designing of high-performance cathode materials for lithium ion batteries is emerging as a major task in view of the wide range of applications ranging from cell phones to electric vehicles and also in medical equipment. Usually, lithiated transition metal oxides, namely, $LiCoO_2$, $LiNiO_2$, and $LiMn_2O_4$, are employed as cathode materials. However, among these mentioned materials, lithium cobalt oxide ($LiCoO_2$) is the most widely used in the majority of commercially available lithium ion batteries owing to its ease of synthesis and high reversibility.[1] In view of the advantages associated with $LiCoO_2$, the maximum attainable practical capacity is only around 137 mA·h/g when cycled in the voltage range 3–4.25 V, although the theoretical capacity is as high as 273.8 mA·h/g. Therefore, to obtain higher capacities, one has to charge the cells to high voltages (4.5 V).[2] However, such attempts failed to produce stable $LiCoO_2$ due to structural changes taking place[3] during cycling. Attempts to improve the cycleability beyond 4.25 V have been reported by some authors[4,5] by doping with either Mg or Al. However, such results only report inferior capacities. Theoretical studies[6,7] suggest that doping of $LiCoO_2$ with a transition metal ion leads to an increase in capacity whereas on the other hand non-transition-metal ion doping leads to an increase in voltage at the expense of capacity. To overcome the cycling problems at high voltages, very recently, Cho et al.[8–10] demonstrated that coating of $LiCoO_2$ with ceramic materials such as Al_2O_3 and ZrO_2 is the only available option for obtaining stable capacities when cycled up to 4.5 V and this was confirmed by Dahn et al.[2] However, apart from these studies to the best of our knowledge there is no report on the stable cycling of doped $LiCoO_2$ at high voltages (4.5 V). Hence, we thought it timely to synthesize carefully doped $LiCoO_2$ involving dopant ions such as Mn, Cu, Fe, and Zn and present in this communication the physical and electrochemical characterization of the synthesized materials for use in lithium rechargeable cells. Moreover, the present method of synthesis is advantageous from a commercial and economic point of view.

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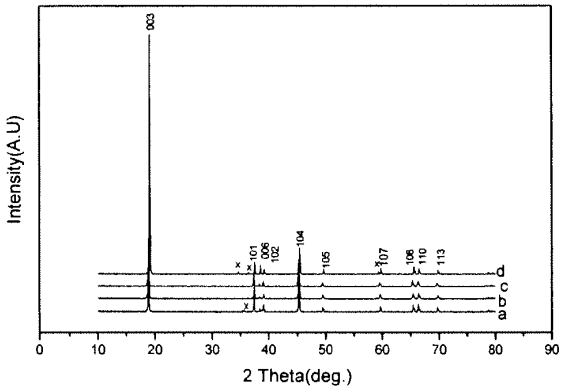

Figure 1. XRD patterns of $LiM_{0.05}Co_{0.95}O_2$, M = (a) Cu, (b) Mn, (c) Fe, and (d) Zn.

Experimental Section. $LiM_{0.05}Co_{0.95}O_2$ (M = Mn, Cu, Fe, and Zn) has been prepared by thoroughly mixing stoichiometric amounts of Co_3O_4 (>99.9% pure), Li_2CO_3, and either $Mn(NO_3)_2$, $Cu(NO_3)_3$, FeO(OH), or $Zn(CH_3COO)_2$, melted in an argon atmosphere at 550 °C for 6 h, and then cooled. The synthesized powders were ground and mixed well before finally annealing at 850 °C for 10 h and then cooled, mixed, and annealed further for 10 h. The mixture was cooled, mixed thoroughly, and subjected to physical and electrochemical characterization.

The prepared powders were characterized for their phase purity and structural features using powder X-ray diffraction (XRD, Rint 1000, Rigaku) using Cu Kα radiation. The particle morphologies of the powders were recorded using a scanning electron microscope (JSM-5300E, Japan Electron Ltd., Japan).

Electrochemical characterizations were performed in a 2032 coin cell type two-electrode assembly. A cathode mix was prepared by using 85% of the active material mixed with 15% Teflonized carbon. The prepared mix was coated onto aluminum foil using doctor blade technique and dried in an oven for 6−12 h at 120 °C. The dried sheet of the cathode material was then roll-pressed for increased adherence of the cathode mixture onto the aluminum foil current collector. Circular disks of the cathodes were then punched and were used for fabricating the coin cell. The coin type cells were assembled in an argon-filled glovebox with the prepared circular disks of $LiM_{0.05}Co_{0.95}O_2$ as the cathode and lithium (Cyprus Foote Mineral Co.) metal anode and with Celgard 3401 as the separator using 1 M $LiPF_6$ in 1:2 by volume ethylene carbonate (EC)/dimethyl carbonate (DMC) [Ube Chemical, Japan] as electrolyte solution. The galvanostatic cycling studies of the fabricated cells were performed at a C/5 rate in the voltage range 3.5−4.5 V using an automatic battery tester at room temperature.

Results and Discussion. Figure 1 presents the XRD patterns of the synthesized $LiM_{0.05}Co_{1.95}O_2$ [M = Mn, Fe, Cu, and Zn]. It can be observed from Figure 1 that all the patterns can be indexed to the α-$NaFeO_2$ structure as all the fingerprint peaks, viz., 003, 101, 006, 102, 104, 108, and 110, are clearly assignable. The hexagonal lattice parameters of the synthesized powders were evaluated by using a least-squares fit and the values of *a* and *c* are presented in Table 1 along with the *c*/*a* ratio, an indicator of metal−metal layering distance. It is interesting to observe that the XRD patterns of Zn-doped $LiCoO_2$ shows the formations of some secondary phases and the intensity of 006 is higher than that of the 102 peak. This suggests the *R*-factor, i.e., the ratio of [006/102]/101 as suggested by Reimers et al.,[11] is higher and so results in the distortion of the hexagonal setting. Moreover, the abnormal intensity of the 003 peak may be ascribed to the inhomogeneous distribution of Zn and Co ions. However, in all other cases no such abnormality is observed, which can be confirmed by the perfect hexagonal setting. As can be seen, all other XRD patterns have a perfect 006/102 and 108/110 doublet splitting as seen in pristine $LiCoO_2$[12] and therefore could be inferred to have perfect layering involving the metal ions and oxygen atoms. As can be observed from Table 1, the values of *a* are similar while those of *c* are higher than the pristine $LiCoO_2$ with the *c*/*a* ratio of above 4.991, thereby suggesting improved layering characteristics and therefore the ions should exhibit excellent electrochemical behavior. Such an increase in lattice parameters is understandable in view of the higher ionic radii of the present dopant ions as compared to high spin cobalt (0.565 Å). Our results confirm the reports available in the literature.[13]

Table 1. XRD Lattice Constants *a* and *c* and *c*/*a* Ratio for Differently Synthesized Doped $LiCoO_2$

material	*a*	*c*	*c*/*a*
$LiCu_{0.05}Co_{0.95}O_2$	2.817	14.059	4.991
$LiMn_{0.05}Co_{0.95}O_2$	2.814	14.065	4.997
$LiFe_{0.05}Co_{0.95}O_2$	2.817	14.088	5.001
$LiZn_{0.05}Co_{0.95}O_2$	2.816	14.165	5.030

Figure 2. Typical SEM photograph of $LiMn_{0.05}Co_{0.95}O_2$.

Having confirmed the formation of metal ion doped materials, we examined the surface morphology of the synthesized materials using SEM. Figure 2 depicts a typical SEM photograph of the synthesized manganese doped $LiCoO_2$ powders. It is interesting to see that a different type of morphology is adopted by doping with metal ions. The SEM photographs reveal that the particle size is more than 3 μm in the case of Cu and Zn ion doping while on the other hand a slight reduction

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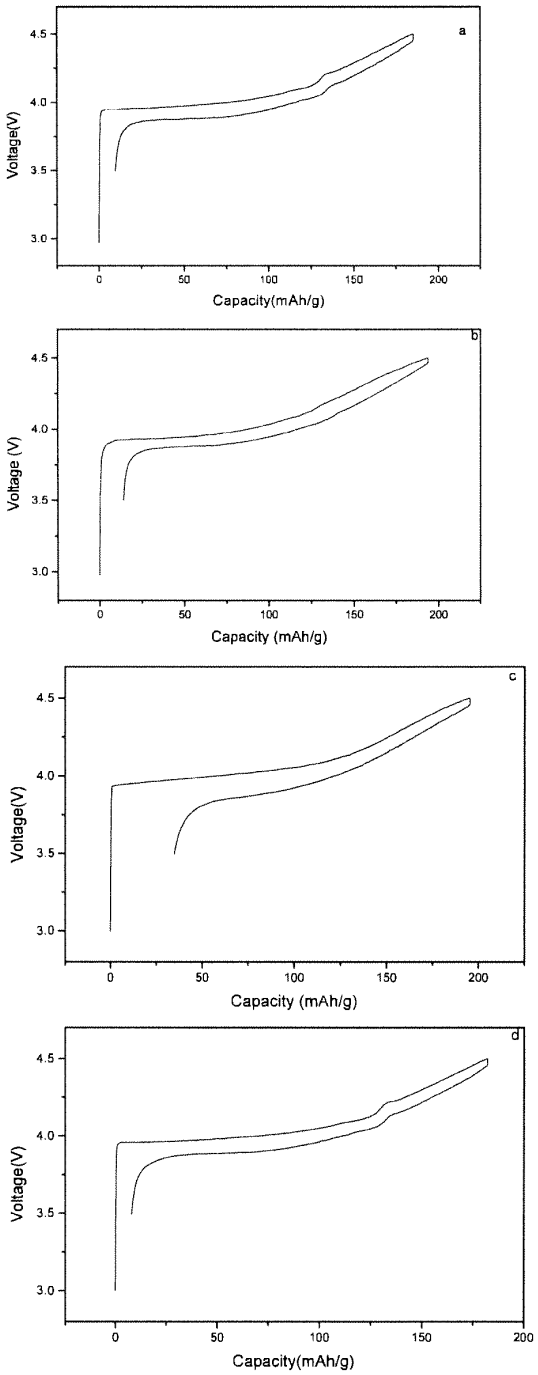

Figure 3. First charge/discharge patterns of $LiM_{0.05}Co_{0.95}O_2$, M = (a) Cu, (b) Mn, (c) Fe, and (d) Zn.

in particle size is observed in the case of Fe dopant. Indeed, the SEM photograph of Mn doping is still exciting as each particle is made up of aggregates of smaller particles and forms a cluster. Such kind of reduction in particle size indicates that the lithium ions could easily insert and deintercalate due to reduction in path lengths.

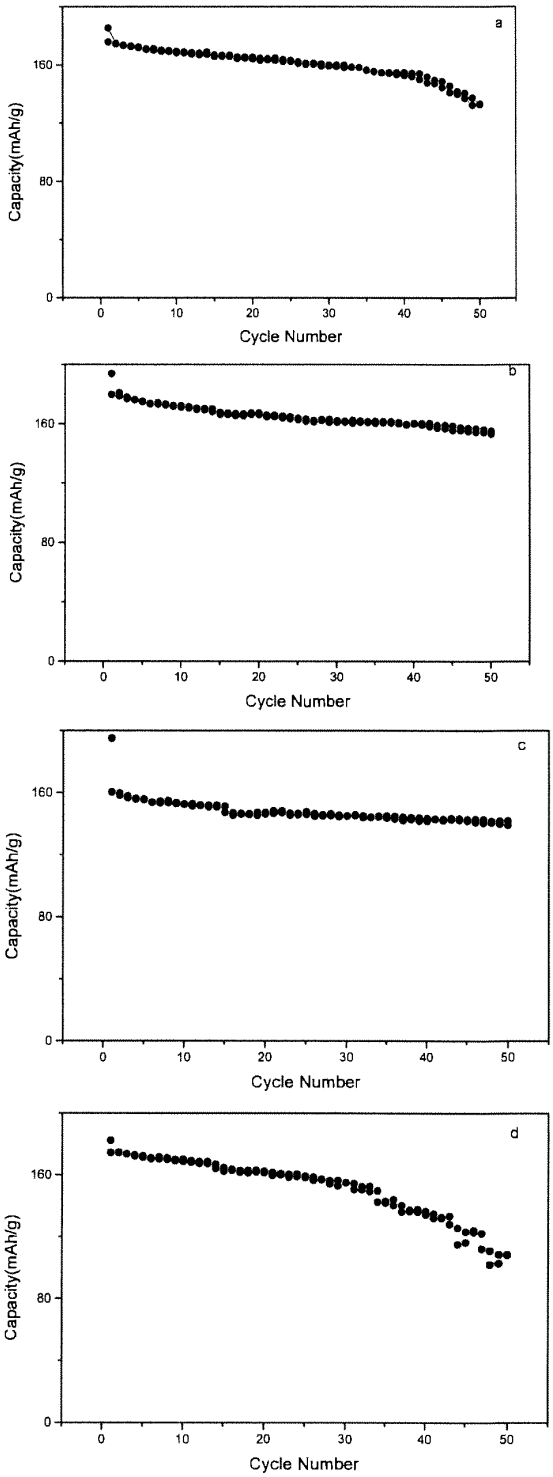

Figure 4. Galvanostatic cycling at a C/5 rate in the voltage range 3.5−4.5 V of $LiM_{0.05}Co_{0.95}O_2$, M = (a) Cu, (b) Mn, (c) Fe, and (d) Zn.

Electrochemical performance of the fabricated 2032 lithium coin cell was evaluated galvanostatically by

cycling the cells from 3.5 to 4.5 V. The cells exhibited an open circuit voltage of around 3.0 V (vs Li metal). The first charge and discharge pattern for the cells incorporating the synthesized materials are presented in Figure 3. It is observed that all the cells employing the doping elements exhibit high first charge of around 190 mA·h/g but the irreversible capacity is different and depends on the dopant ions. The first cycle irreversible capacities in the case of Mn, Cu, and Zn are similar and is ~15 mA·h/g when cycled up to 4.5 V and hence could be potential materials for use in lithium ion batteries. Further, it is interesting to note that the irreversible first cycle capacity of $LiFe_{0.05}Co_{0.95}O_2$ is very large (~40 mA·h/g), thereby suggesting poor cycleability at high voltages (4.5 V). A comparison of the first charge and discharge profile suggests the existence of two phase oxidation/reduction in the case of Cu and Zn doped $LiCoO_2$ (Figure 3a,d) and hence could lead to inferior capacities on extended cycling like in the case of pristine $LiCoO_2$. Thus, we observe a phase change around 130–135 mA·h/g in these materials. It is worthwhile to recall here that the XRD patterns also confirm the existence of some secondary phases marked "x" in these materials. However, such phase changes are not noticeable in the case of $LiFe_{0.05}Co_{0.95}O_2$ and $LiMn_{0.05}Co_{0.95}O_2$ (Figure 3b,c) and hence is expected to deliver stable capacities on high-voltage cycling. Encouraged by the preliminary performance of the synthesized powders, we were interested in carrying out the extended galvanostatic cycling studies (50 cycles) so as to ascertain the stability of the initially observed high capacities.

The galvanostatic cycling behavior of the synthesized doped cathode materials were evaluated in a lithium rechargeable 2032 type coin cell in the voltage range 3.5–4.5 V at a C/5 rate and are presented in Figure 4a–d. It is observed from the figures that the cells employing Cu and Zn doping (Figure 4a,d) show initial discharge capacities of around 165–170 mA·h/g but fade slowly on cycling and retain a capacity of approximately 130 and 110 mA·h/g, respectively. Such kind of fading has also been observed by other authors in the case of $LiCoO_2$[3] and has been ascribed due to the different phase changes taking place on cycling. It is interesting to observe the excellent cycleability exhibited by either Fe or Mg doped material (Figure 4b,c) over the investigated 50 cycles. However, as indicated elsewhere, Fe doped $LiCoO_2$ has the highest irreversible capacity and hence delivers a stable capacity of around 145 mA·h/g after 50 cycles. Further, looking at the cycleability of $LiMn_{0.05}Co_{0.95}O_2$, we observe not only good stable capacities delivered at high-voltage cycling (4.5 V) but also

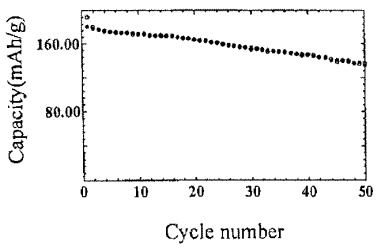

Figure 5. Galvanostatic cycling at a C/5 rate in the voltage range 3.5–4.5 V of $LiCoO_2$.

at the same time delivery of the highest capacities of ~158 mA·h/g. This result looks very interesting as to our knowledge this is the first time such stable high-voltage capacities are obtained, even though some authors suggest improved performance up to 4.5 V involving only coating of $LiCoO_2$.[8] The enhanced performance of Mn doping cycling up to 4.5 V can be ascribed to the absence of phase changes. Last, the cycleability of Mn doped $LiCoO_2$ [Figure 4b] delivers initial discharge capacities of around 180 mA·h/g and becomes stabilized from the 15th cycle and delivers a capacity of ~158 mA·h/g at the 50th cycle. Thus, we can say that doping with manganese could deliver high capacities and also produce good high-voltage cycling cathode materials. Moreover, $LiCoO_2$ synthesized under identical conditions delivers only a discharge capacity of around 138 mA·h/g after 50 cycles (Figure 5). Further, a comparison of our capacities with that obtained by coating[8–10] of $LiCoO_2$ indicates that our results are superior in view of the high capacities obtained in a narrow voltage range of 3.5–4.5 V in contrast to values of ~165 mA·h/g reported by Cho et al.,[8] in the voltage range 2.75–4.4 V.

Conclusion. We may therefore conclude that doped $LiCoO_2$ materials synthesized by the present technique result in enhanced stable capacities at high voltages (4.5 V). Thus, we demonstrate for the first time that the material, $LiMn_{0.05}Co_{0.95}O_2$, is a promising cathode material for use in lithium rechargeable cells delivering capacities of 158 mA·h/g at a C/5 rate when cycled between 3.5 and 4.5 V.

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Electronic Patent Application Fee Transmittal	
Application Number:	10491134
Filing Date:	06-May-2004
Title of Invention:	Secondary lithium ion cell or battery, and protecting circuit, electronic device, and charging device of the same
First Named Inventor/Applicant Name:	Xiaoping Ren
Filer:	Stephen A. Bent/Linda Novak
Attorney Docket Number:	042787-0106
Filed as Small Entity	

U.S. National Stage under 35 USC 371 Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Claims in excess of 20	2615	1	26	26
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 1 month with $0 paid	2251	1	65	65
Miscellaneous:				
		Total in USD ($)		**91**

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Application Number:	10491134
International Application Number:	
Confirmation Number:	7003
Title of Invention:	Secondary lithium ion cell or battery, and protecting circuit, electronic device, and charging device of the same
First Named Inventor/Applicant Name:	Xiaoping Ren
Customer Number:	22428
Filer:	Stephen A. Bent/Linda Novak
Filer Authorized By:	Stephen A. Bent
Attorney Docket Number:	042787-0106
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	Amendment/Req. Reconsideration-After Non-Final Reject	4	4
	Claims	5	8
	Applicant Arguments/Remarks Made in an Amendment	9	19

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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 AND TRADEMARK OFFICE

Applicant:	Xiaoping REN et al.
Title:	SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME
Appl. No.:	10/491,134
International Filing Date:	09/28/2002
371(c) Date:	05/06/2004
Examiner:	Muhammad S. Siddiquee
Art Unit:	1795
Confirmation Number:	7003

AMENDMENT TRANSMITTAL

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

Sir:

Transmitted herewith is an amendment in the above-identified application.

[**X**] Small Entity status under 37 C.F.R. § 1.9 and § 1.27 has been established by a previous assertion of Small Entity status.

[ ] Assertion of Small Entity status is enclosed.

[**X**] The fee required for additional claims is calculated below:

	Claims As Amended		Previously Paid For		Extra Claims Present		Rate		Additional Claims Fee
Total Claims:	21	-	20	=	1	x	$52.00	=	$52.00
Independent Claims:	4	-	4	=	0	x	$220.00	=	$0.00
First presentation of any Multiple Dependent Claims:						+	$390.00	=	$0.00
							CLAIMS FEE TOTAL	=	$52.00

[**X**] Applicant hereby petitions for an extension of time under 37 C.F.R. §1.136(a) for the total number of months checked below:

[X]	Extension for response filed within the first month:	$130.00	$130.00
[ ]	Extension for response filed within the second month:	$490.00	$0.00
[ ]	Extension for response filed within the third month:	$1,110.00	$0.00
[ ]	Extension for response filed within the fourth month:	$1,730.00	$0.00
[ ]	Extension for response filed within the fifth month:	$2,350.00	$0.00
		EXTENSION FEE TOTAL:	$130.00
[ ]	Statutory Disclaimer Fee under 37 C.F.R. 1.20(d):	$140.00	$0.00
		CLAIMS, EXTENSION AND DISCLAIMER FEE TOTAL:	$182.00
[X]		Small Entity Fees Apply (subtract ½ of above):	$91.00
		Extension Fees Previously Paid:	$0.00
		TOTAL FEE:	$91.00

The above-identified fees of $91.00 are being paid by credit card via EFS-Web.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by the credit card payment instructions in EFS-Web being incorrect or absent, resulting in a rejected or

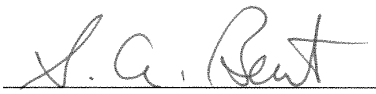
incorrect credit card transaction, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

If any extensions of time are needed for timely acceptance of papers submitted herewith, applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Please direct all correspondence to the undersigned attorney or agent at the address indicated below.

Respectfully submitted,

Date May 15, 2009

By 

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
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 displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 10/491,134	Filing Date 05/06/2004	☐ To be Mailed

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	385		N/A	
☒ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	0		N/A	
☒ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	0		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 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	385		TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
AMENDMENT	05/15/2009	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $26 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $110 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

		(Column 1)		(Column 2)	(Column 3)					
AMENDMENT		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 $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	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 number found in the appropriate box in column 1.

Legal Instrument Examiner:
/KATINA TOBIN/

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.

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.
10/491,134	05/06/2004	Xiaoping Ren	042787-0106	7003

22428 7590 01/16/2009
FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

EXAMINER	
SIDDIQUEE, MUHAMMAD S	
ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
01/16/2009	PAPER

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.

Office Action Summary	Application No.	Applicant(s)	
	10/491,134	REN ET AL.	
	Examiner	Art Unit	
	MUHAMMAD SIDDIQUEE	1795	

-- 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 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *21 October 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ 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

4)☒ Claim(s) *1-17* is/are pending in the application.

4a) Of the above claim(s) *11-17* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

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

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Objections

1. Claim 1 is objected to because of the following informalities: claim 1 recites "the single cell is from 1:1.0 to 1:2.5, ***5,*** as calculated" . Appropriate correction is required.

Response to Arguments

2. Applicant's arguments with respect to claims 1-10 have been considered but are moot in view of the new ground(s) of rejection.

Priority

3. Receipt is acknowledged of translation of foreign priority submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) 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.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Idota (US 5,260,148) in view of Tanaka (5,487,960).

Regarding claims 1-10, Idota discloses a lithium secondary battery comprising an anode and a cathode where the ratio of the equivalent amount of the anode (negative electrode) active material to that of the cathode (positive electrode) active material be larger than 1 (i.e., the amount of the anode active material is more than equivalent to the cathode active material). The ratio thereof is more preferably from 1.1 to 5, most preferably from 1.1 to 3.5. [column 3, lines 14-19]. Idota does not specifically disclose

battery is capable of being charged to between 4.2 volts to 5.8 volts. However, Tanaka discloses a nonaqueous secondary battery having improved safety in case of abrupt temperature rise, which is capable of intercalating and deintercalating a lithium ion and has a charging cut-off voltage of 3.5 to 5 V [column 1, lines 39-43; column 3, lines 21-49]. Improving capacity, average operating voltage and specific energy of a secondary lithium ion battery with known method and advantages in the prior art is within the reach of an ordinary skilled artisan. Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to utilize cut-off voltage as taught by Tanaka in the battery of Idota in order to have a safer and thereby an efficient battery.

9. Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Idota (US 5,260,148) in view of Kobayashi et al (US 6,558,848 B1).

Regarding claims 1-10, Idota discloses a lithium secondary battery comprising an anode and a cathode where the ratio of the equivalent amount of the anode (negative electrode) active material to that of the cathode (positive electrode) active material be larger than 1 (i.e., the amount of the anode active material is more than equivalent to the cathode active material). The ratio thereof is more preferably from 1.1 to 5, most preferably from 1.1 to 3.5. [column 3, lines 14-19]. Idota does not specifically disclose battery is capable of being charged to between 4.2 volts to 5.8 volts. However, Kobayashi discloses secondary battery where in the case of lithium secondary cells, the charge cut-off voltage was set at 4.5V and discharge cut-off voltage at 4.5V [column 20, lines 24-31]. Overcharging protection release voltage is inherent in the battery.

Improving capacity, average operating voltage and specific energy of a secondary lithium ion battery with known method and advantages in the prior art is within the reach of an ordinary skilled artisan. Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to utilize cut-off voltage as taught by Tanaka in the battery of Idota in order to have a safer and thereby an efficient battery.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MUHAMMAD SIDDIQUEE whose telephone number is (571) 270-3719. The examiner can normally be reached on Monday-Thursday, 7:30 am to 4:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MSS

/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1795

Notice of References Cited	Application/Control No. 10/491,134	Applicant(s)/Patent Under Reexamination REN ET AL.	
	Examiner MUHAMMAD SIDDIQUEE	Art Unit 1795	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,487,960	01-1996	Tanaka, Mitsutoshi	429/332
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	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 MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/21/2008	07/12/2008	01/12/2009						
	1	÷	✓	✓						
	2	÷	✓	✓						
	3	÷	✓	✓						
	4	÷	✓	✓						
	5	÷	✓	✓						
	6	÷	✓	✓						
	7	÷	✓	✓						
	8	÷	✓	✓						
	9	÷	✓	✓						
	10	÷	✓	✓						
	11	÷	N	N						
	12	÷	N	N						
	13	÷	N	N						
	14	÷	N	N						
	15	÷	N	N						
	16	÷	N	N						
	17	÷	N	N						

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

SEARCHED			
Class	Subclass	Date	Examiner
429	60, 231.95	7/11/2008	MSS

SEARCH NOTES		
Search Notes	Date	Examiner
Consulted with Gregg Cantelmo in Art unit 1795	7/11/2008	MSS
Searched for Inventor in EAST and PALM (assignee info is not avaiable in PALM)	7/11/2008	MSS
Searched USPAT, US-PGPUB, EPO, JPO, DERWENT	7/11/2008	MSS
Class 429/60, 231.95 was limited by text, see EAST search history.	7/11/2008	MSS
Text Searched, see EAST search results.	1/9/2009	MSS
Consulted with Jonathan Crepeau in Art unit 1795	1/9/2009	MSS

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

/MUHAMMAD SIDDIQUEE/ Examiner.Art Unit 1795	

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	6	US-1135103-$.DID. OR US-1185860-$.DID. OR JP-2000270491-$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2008/07/09 11:57
S2	2	"5604418".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2008/07/09 11:59
S3	1	"5604418".pn.	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/09 11:59
S4	196	US-5743921-$.DID. OR US-5920181-$.DID. OR US-5969502-$.DID. OR US-5648187-$.DID. OR US-5962166-$.DID. OR US-5986430-$.DID. OR US-6194874-$.DID. OR US-5998051-$.DID. OR US-5604057-$.DID. OR US-6025696-$.DID. OR US-5674644-$.DID. OR US-6043629-$.DID. OR US-6137265-$.DID. OR US-6046514-$.DID. OR US-5939864-$.DID. OR US-6046575-$.DID. OR US-6114835-$.DID. OR US-6075343-$.DID. OR US-4888258-$.DID. OR US-6104165-$.DID. OR US-5192629-$.DID. OR US-6127804-$.DID. OR US-5587133-$.DID. OR US-6221531-$.DID. OR US-5631539-$.DID. OR US-5635138-$.DID. OR US-6228528-$.DID. OR US-5705291-$.DID. OR US-6242893-$.DID. OR US-6057670-$.DID. OR US-6245464-$.DID. OR US-6091227-$.DID. OR US-4299890-$.DID. OR US-6143444-$.DID. OR US-4362794-$.DID. OR US-6204634-$.DID. OR US-4414093-$.DID. OR US-4268587-$.DID. OR US-5196279-$.DID. OR	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2008/07/09 12:01

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		US-5209871-$.DID. OR					
		US-5686808-$.DID. OR					
		US-5215821-$.DID. OR					
		US-5763119-$.DID. OR					
		US-5225056-$.DID. OR					
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		US-5932373-$.DID. OR					

		US-5858573-$.DID. OR US-5945804-$.DID. OR US-5903137-$.DID. OR US-5963019-$.DID.				
S5	16	(SUN-JIE or REN-XIAOPING).in.	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/09 12:03
S7	1	10/491134	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/09 12:04
S18	17537	(charge near5 ((cut-off or cut off) near5 voltage) or ((cut-off or cut off) near5 voltage))	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:21
S19	12169	S18 not (battery or celectrochemical cell)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:22
S20	5368	S18 not S19	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:22
S21	2857	(positive electrode or negative electrode or anode or cathode) near5 material with ratio	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:23
S22	724	S21 not (battery or celectrochemical cell)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:23
S23	2133	S21 not S22	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:24
S24	5	S20 same S23	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:24
S25	153	S20 and S23	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:24
S26	62	S25 and @ad<"20020928"	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:25
S27	9	JP-01304664-$.DID. OR WO-03030293-$.DID. OR WO-2004021502-$.DID. OR EP-1189299-$.DID. OR EP-1324418-$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2008/07/11 18:36
S28	9	US-7128998-$.DID. OR US-5464705-$.DID. OR US-20010024757-$.DID. OR US-20040209156-$.DID. OR US-20050196664-$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2008/07/11 18:37
S29	924	(ratio with positive adj electrode with negative adj electrode with material) or (ratio with anode with cathode with material)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 19:31

S30	97	(ratio near5 positive adj electrode near5 negative adj electrode near5 material) or (ratio near5 anode near5 cathode near5 material)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 19:33
S31	5	S20 and S30	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 19:38
S32	0	S26 and (overcharg$4 near5 protect$4 near5 voltage)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:53
S33	228	(overcharg$4 near5 protect$4 near5 voltage)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:53
S34	0	S30 and (overcharg$4 near5 protect$4 near5 voltage)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:54
S35	0	S30 and S33	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:54
S36	116	S33 and @ad<"20020928"	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:55
S37	5	S30 and (overcharg$4 near5 voltage)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:57
S38	4	S26 and (overcharg$4 near5 voltage)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:57
S39	44	S26 and (charg$4 near5 volt$4) and dischard$4 near5 volt$4	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 21:01
S40	38	S26 and((charg$4 near5 volt$4) with (dischard$4 near5 volt$4))	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 21:01
S41	2	09/768298	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 09:08
S42	1	10/320319	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 09:13
S43	8	US-6453198-$.DID. OR US-6544689-$.DID. OR US-6617074-$.DID. OR US-6706441-$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2008/07/12 10:10
S44	15	overcharge near5 releas $4 near5 volt$4	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 12:50
S45	146	429/60.ccls.	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:17
S46	97	S45 and (ratio near5 positive adj electrode near5 negative adj electrode near5 material) or (ratio near5 anode near5 cathode near5 material)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:18

S48	1737	429/231.95.ccls.	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:20
S49	710	S48 and (charg$4 near5 volt$4) and discharg$4 near5 volt$4	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:22
S50	22	(SUN-JIE or REN-XIAOPING).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	NEAR	ON	2008/07/12 13:23
S51	1	S50 and (charg$4 near5 volt$4) and discharg$4 near5 volt$4	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:24
S52	1	"5654622".pn.	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/02 18:23
S53	8	US-1135103-$.DID. OR US-1185860-$.DID. OR US-5604418-$.DID. OR JP-2000270491-$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2009/01/02 18:27
S55	1	10/491134	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/02 18:33
S56	17919	(charge near5 ((cut-off or cut off) near5 voltage) or ((cut-off or cut off) near5 voltage))	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/02 18:36
S57	99	S56 same ("4.3" V or "4.4" V or "4.5" V or "4.6" V)	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/02 18:38
S58	129	S56 same ("4.2" V)	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/02 18:38
S59	5	"6558848"	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/10 16:26
S60	39	(US-20030082448-$ or US-20030049534-$ or US-20040209156-$ or US-20010024757-$ or US-20020098416-$ or US-20020086214-$ or US-20020076612-$ or US-20030113613-$ or US-20010023983-$).did. or (US-5604418-$ or US-5464705-$ or US-7135251-$ or US-6998071-$ or US-6949312-$ or US-6617073-$ or US-6558847-$ or US-6558843-$ or US-6436577-$ or US-5478673-$ or US-7001690-$ or US-	US-PGPUB; USPAT; EPO; JPO; DERWENT	NEAR	ON	2009/01/10 16:30

		6528033-$ or US-6451483-$ or US-6268087-$ or US-5882218-$ or US-5744264-$ or US-5716728-$ or US-5344431-$ or US-5260148-$ or US-6071489-$ or US-6040090-$ or US-5998063-$ or US-5965293-$ or US-6756154-$ or US-6558848-$ or US-6497980-$).did. or (US-5654622-$).did. or (EP-1189299-$).did. or (JP-2000270491-$).did. or (JP-2000270491-$ or US-20010024757-A-$ or EP-1189299-A-$).did.				
S61	18	S60 and cut-off voltage	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/10 16:31
S62	9	cut-off voltage with "4.5V"	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/10 16:43
S63	46	cut-off voltage with ("4.5V" or "4.4V" or "4.35V" or "4.3" V)	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/10 16:45
S64	32	TANAKA-MITSUTOSHI.in.	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/10 17:07
S65	171	TANAKA-MITSUTOSHI.in.	JPO	NEAR	ON	2009/01/10 17:08
S68	10	S65 and ratio	JPO	NEAR	ON	2009/01/10 17:09
S69	980	(ratio with positive adj electrode with negative adj electrode with material) or (ratio with anode with cathode with material)	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/10 18:28
S70	24	((cut-off or cut off) near3 voltage) with ("4.5V" or "4.4V" or "4.35V" or "4.3V")	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/10 18:31
S71	1963	(((cut-off or cut off) near3 voltage) or voltage) with ("4.5V" or "4.4V" or "4.35V" or "4.3V")	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/10 18:32
S72	28	S69 and S71	US-PGPUB; USPAT; USOCR	NEAR	ON	2009/01/10 18:32

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Xiaopint REN et al.
Title:	SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME
Appl. No.:	10/491,134
Filing Date:	12/6/2006
Examiner:	Wensing W. Kuo
Art Unit:	1795
Confirmation Number:	7003

TRANSLATOR'S DECLARATION

I, the below-named translator, certify that I am familiar with both the Chinese and the English language, and that I have prepared the attached English translations, as follow:

Exhibit A: Translation of Chinese patent application filed September 28, 2001 and assigned Chinese Application Number 011416157.

I further certify that these English translations are true, faithful and exact translations of the corresponding Chinese language documents.

I further declare that all statements made in this declaration of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful, false statements may jeopardize the validity of legal decisions of any nature based on them.

Oct. 30, 2008	Li, Fan	Fan Li
Date	Printed Name	Signature

WASH_4928483.1

SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE

TECHNICAL FIELD

The present invention relates to a new method for improving capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, and to a secondary lithium ion cell or battery prepared by using the method, a protecting circuit adapted for the secondary lithium ion cell or battery, a electronic device using the secondary lithium ion cell or battery.

BACKGROUND ART

The industry of lithium ion cell develops quickly since SONY corporation of Japan invented and commercialized a secondary lithium ion cell in 1990. Up to 2000, the manufactures of lithium ion battery around the world compete allsidedly for improving the competitive power of their products mainly around the key issue, the capacity of lithium ion battery. At present, the improvement of capacity of commercialized secondary lithium ion battery generally depends on the increase of loading quantities of active substances (positive electrode materials and negative electrode materials). However, the limitation of the volume of lithium ion battery greatly restricts the increase of the battery capacity. For notably raising the capacity, the researches for the development of active substances (positive electrode materials and negative electrode materials) having higher specific energy are been conducting around the world, but so far, there is no notable breakthrough in this aspect for various technical difficulties.

In fact, the positive electrode materials and negative electrode materials used in the current secondary lithium ion battery have relatively higher theoretical capacity, and the problem merely lies in the lower actual utilization rate of said capacity. For example, lithium cobalt oxides as a positive electrode material of secondary lithium ion cell has a theoretical capacity of 248 mAh/g, while the actually used capacity of it is merely about 140 mAh/g, i.e., about half of said theoretic capacity is not utilized. This is mainly caused by the limitation of charge cut-off voltage commonly used in the art. At present, the charge cut-off voltage of single secondary lithium ion cell is limited to no more than 4.2 V, and this is well accepted as a technical requirement in the industry of manufacture of secondary lithium ion battery. Further, all lithium ion batteries in the markets around the world are manufactured under this technical requirement. For example, the charge cut-off voltage is limited to below 4.2 V and the overcharge release voltage of its protection circuit is controlled below 4.15 V during the formation of single lithium ion cell. The reasons that the charge cut-off voltage being limited to below 4.2 V lie in the following opinions in the prior research results and documents: although the capacity and average operating voltage are improved by increasing the charge cut-off voltage, the positive electrode materials and the negative electrode materials will undergo structure change, the electrolyte may decompose, and the recycle property of the cell will be adversely affected when the charge cut-off voltage is greater than 4.2 V.

For instance, as to lithium cobalt oxides that is used as positive electrode material in the most commercial lithium ion batteries, the charge cut-off voltage is limited to below 4.2 V and the actual capacity is 120-130 mAh/g, i.e., about 50% of the theoretical capacity, although many documents indicate that the charge cut-off voltage can be over 4.2 V for a test cell using metallic lithium as counter electrode. In fact, according to MIZUSHIMAK et al., "A new cathode material for batteries of high energy density", Mater. Res. Bull., 1980, 15:783, the quantity of dedoped lithium ion increases with the increase of charge voltage, and the electrochemical capacity of lithium cobalt oxides increases accordingly. However, the study deems that the reversible charge-discharge voltage is about 4.3 V when metallic lithium is used as counter electrode, and when said voltage is higher than 4.3 V, the structure of lithium cobalt oxides changes and the lattice parameter C decreases from 4.4 nm to 4.0 nm, and thus the recycle life of cell is affected.

G. PISTOIA et al., J. Power Source, 56(1995), 37-43, deems that the structure the lithium cobalt oxides changes with the charge voltage, and the coexistence of monoclinic phase and hexagonal phase will appear when the charge voltage is over a certain value, which will spoil the recycle property of cell. The results of experiments showed that as to a test button cell having metallic lithium as negative electrode, the capacity of lithium cobalt oxides reaches 159 mAh/g when the charge cut-off voltage is 4.35 V, but it drops to 135 mAh/g after several cycles; and the capacity attenuates quickly when the charge cut-off voltage is 4.25 V. This document takes the opinion that lithium cobalt oxides maintains excellent recycle property and a capacity about 130 mAh/g only when the charge cut-off voltage is 4.15 V, and the corresponding voltages of monoclinic phase and hexagonal phase separately is 4.05 V and 4.17 V, i.e., both of them are below 4.2 V.

In addition, Lei Yongquan, "Materials for New Energy" (in Chinese), 2000, p136, discloses that the decomposition voltage of electrolyte solution using $LiPF_6$ as electrolyte and EC/DMC as mixture solvent is 4.2 V, and thus deems that the electrolyte solution will be decomposed and the recycle life will be affected when the charge cut-off voltage is above 4.2 V.

In 1990, Sony Corporation issued the lithium ion cell using coke as negative electrode, which has a charge cut-off voltage of not more than 4.20 V, and it is accepted as a common technical requirement of lithium ion cells thereafter.

The prior art deems:

1. The increase of charge cut-off voltage will change the structure of positive electrode material, which mainly exhibits at the following two aspects: one aspect is that the phase change, i.e., the coexistence of monoclinic phase and hexagonal phase and the conversion between them may seriously affect the recycle life of lithium ion cell; and another aspect is that the change of

lattice parameter may narrow the channel for passing lithium ions, squeeze the space occupied by lithium ions, jam the channel of lithium ions, and decrease the recycle property of lithium ion cell.

2. The elevated charge cut-off voltage may decompose the electrolyte solution, and the loss of electrolyte solution renders the transportation of lithium ion more difficult, and thus the recycle life of cell is seriously affected.

Therefore, it can be seen that the limitation of charge voltage restricts the actual utilization of active electrode materials. Under this condition, even if new positive electrode material and negative electrode material having higher specific energy are developed, the lithium ion cell cannot exhibit the best performance. Hence, it is urgently needed to provide a method that can improve the efficacy of active substances of lithium ion cell, consequently increase the capacity and average operating voltage, and maintain the better cell performance simultaneously.

SUMMARY OF INVENTION

As to the common opinion in the art that increasing the charge cut-off voltage above 4.2 V may greatly shorten the recycle life, the inventor of the present invention conducted a large number of experiments and studies to elevate the charge cut-off voltage and the capacity of cell. Contrary to this opinion, the inventor unexpectedly found that the efficacy of electrode active materials is greatly increased by increasing the charge cut-off voltage and properly adjusting the ratio of positive electrode material to negative electrode material of single lithium ion cell. Consequently, the specific energy, capacity and average operating voltage of secondary lithium ion cell or battery are improved, while the performance of cell is substantially not changed. The present invention is fulfilled based on the aforesaid discovery.

It is one object of the present invention to provide a new method for improving capacity, average operating voltage and energy density of a secondary lithium ion cell or battery, wherein the charge cut-off voltage of the singe cell is greater than 4.2 V, and less than 5.8 V, and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.

Another object of the present invention is to provide a secondary lithium ion cell or battery, wherein the single secondary lithium ion cell has an charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.

Yet another object of the present invention is to provide a protecting circuit adapted for the secondary lithium ion cell or battery, said protecting circuit having

a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V.

Yet another object of the present invention is to provide an electronic device using the secondary lithium ion cell or battery as power supply, said electronic device comprising a protecting circuit having a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V.

EMBODIMENTS FOR CARRYING OUT THE PRESENT INVENTION

Being contrary to the common opinion in the art that the charge cut-off voltage shall be controlled below 4.2 V, the present inventor unexpectedly found that the capacity, specific energy and average operating voltage of the secondary lithium ion cell or battery were notably improved with little cost and with the other properties substantially unchanged, when investigating the effect of the elevated charge cut-off voltage on the cell performances with a large number of experiments of gradually elevating the charge cut-off voltage and appropriately adjusting the ratio of the positive electrode to the negative electrode of the single lithium ion cell. In the present invention, "lithium ion cell or battery" means that the present invention can be applied to either a single lithium ion cell, or a single lithium ion cell comprising a protecting circuit, or a battery comprising a number of single lithium ion cells, or a battery comprising a number of single lithium ion cell and protecting circuits. For briefness, sometimes it may also be termed as "lithium ion cell". In addition, "theoretical capacities of positive electrode and negative electrode" means the capacities of the positive electrode and the negative electrode calculated with an charge cut-off voltage set at 4.2 V.

The present inventor studied the relation between the charge cut-off voltage and the cell properties of secondary lithium ion cell by gradually elevating the charge cut-off voltage. For example, in the formation test for the commercial secondary single lithium ion cells and the self made single secondary lithium ion cells, the inventor elevated the charge cut-off voltage from 4.2 V to 4.30 V, 4.35 V, 4.40 V, 4.45 V and 4.6 V, and the results showed that when the charge cut-off voltage is, 4.3 V, 4.35 V and 4.40 V, the specific energy of cell increases by 6-20% than that under the charge cut-off voltage of 4.2 V, and the cells still maintain excellent recycle property, e.g., the capacity maintains more than 95% after 50 cycles, and more than 80% after 500 cycles, which is comparative with those under the charge cut-off voltage of 4.2V. However, when the charge cut-off voltage is 4.45 V or high, the specific energy increases by about 30%, but the cell exhibits inferior recycle property, e.g., the capacity maintains merely 83.9% after 6 cycles.

For investigating the reasons of poor recycle property when the charge cut-off voltage is 4.45 V or high, after conducting intensive basic research and theoretical study, the inventor adjusted the ratio of positive electrode material to negative electrode material, i.e., said ratio was adjusted within the range from 1:1.3 to 1:2.5 calculated according to the theoretical capacity under the charge

cut-off voltage of 4.2 V, and then the single lithium ion cell having the adjusted ratios were tested by charging at an charge cut-off voltage of 4.45 V, 4.6 V, 4.8 V, 5.0 V, 5.2 V, 5.4 V, 5.6 V and 5.8 V, preferably said charging tests were conducted during the formation and test of the cells. Experimental results show that the specific energy was greatly increased under the charge cut-off voltage of 4.45 V or higher, and the corresponding recycle property was essentially not affected, when appropriate ratios of positive electrode material to negative electrode material were adopted.

In the present method, the elevating of the charge cut-off voltage is advantageously carried out during the formation and examination of the cell. The use of charge cut-off voltage of 4.20 V or high could increase the specific energy of cell, the capacity of positive electrode active material and the average operating voltage, and activate the cell so that the cell reaches its optimal working state with simultaneously achieving the effect of the formation, substantial improvement of the specific energy of commercial lithium ion cells, and imparting the competitiveness of lithium ion cells without altering the original process.

The mechanism of the above experimental results needs more researches. Without limited by any theory, the presumed reasons are as follows.

1. After the elevation of charge cut-off voltage, the amount of lithium ion dedoped from the positive electrode greatly increases, which renders an unmatched state to the original negative electrode material, and deposition of excessive lithium ions on the surface of negative electrode as metallic lithium, which jam part of the channel for passing lithium ions and result in the reduction of capacity and the deterioration of recycle property. The increase of the amount of negative electrode material meets the requirement of doping the relatively excessive lithium ions, and avoids the deposition of lithium ions on the surface of negative electrode as metallic lithium, and thus the maintaining properties (self-discharge properties) and recycle property are not affected. The suitable ratio of positive electrode material to negative electrode material will avoid the deposition of metallic lithium on the surface of negative electrode and the obstruction of channel for passing lithium ions, and consequently avoid the attenuation of capacity of cell. In particular, when the charge cut-off voltage of lithium ion cell is greater than 4.45 V, the negative electrode material of the ordinary commercial lithium ion cell is still more deficient, and the excessive lithium ions will deposit on the surface of negative electrode and form metallic lithium, which jams the channel for passing lithium ions and attenuates the capacity of cell. The great increase of content of negative electrode could reduce the attenuation of capacity of lithium ion cell caused by the increase of recycle times. According to this viewpoint, the inventor performed a lot of experiments, and the results prove the aforesaid assumption (see the Examples).
2. Within a certain range of charge cut-off voltage, the decomposition of little

electrolyte solution brings about negligible effect on the recycle property of cell. The electrolyte having a high decomposition potential or an additive increasing the decomposition potential of electrolyte solution may bring about better performance. The decomposition of electrolyte solution mainly occurs on the positive electrode. Although prior documents disclosed that the decomposition voltage of the electrolyte solution comprising $LiPF_6$ as electrolyte and the mixture of EC/DMC as solvent on the surface of aluminum foil is 4.2 V, according to the results of experiments, this factor essentially does not affect the recycle life of the currently commercialized lithium ion cell. Namely, even though the electrolyte solution decomposes under a voltage higher than 4.2 V, the electric energy is mainly converted into chemical energy and the electric energy involved in the decomposition of electrolyte is very little, thus, this decomposition of electrolyte can hardly affect the recycle life of the lithium ion cell. As to the voltages above the decomposition voltage, such as above 5.0 V, the substance A can be added into the electrolyte solution, or the electrolyte solution B having a higher decomposition voltage can be used. The decomposition potentials of the components of electrolyte solution commonly used in the art are depicted in Table 1. It can be seen that the lowest decomposition voltage of solvent is above 4.5 V.

Table 1. Decomposition potentials of various mixture electrolyte solutions

Solute	$LiClO_4$	$LiAsF_6$	$LiPF_6$
Mixture solvent	Decomposition potentials (V)	Decomposition potentials (V)	Decomposition potentials (V)
PC:DME	4.51	4.72	
PC:DEC	4.5	4.5	
PC:EC		4.5	
PC:EC:DME	4.5	4.62	
PC:DEC:2MLF		4.52	
EC:DEC		4.9	4.8
EC:DMC			4.9
B			5.9

3. As to the reason that the lithium ion cell does not appear attenuation of capacity caused by the change of structure as mentioned in the prior documents when the charge cut-off voltage is above 4.2 V, it may be due to that: after the ithium ions first intercalaton into anode, there is about 10% lithium ions which form a SEI film, so that the actual space of the lithium ions is more than the space that should be occupied by the lithium ions, i.e., the space available to the lithium ions exceeds about 10% of the space needed by the activated lithium ions, thus, although the elevation of the charge voltage changes the structure of positive electrode material, i.e., reduces the lattice parameter, the recycle life is not affected because the space occupied by the actually deintercalation and intercalation lithium ions is less than the space actually possessed by the positive electrode material, and thus the

change of structure in a certain extent will not obstruct the dedoping and doping of lithium ions and will not affect the recycle life of cell. Using positive material more stable in structure with respect to the change of charge voltage exhibit better performance. Although the positive electrode generates inert substance poor in conductivity when overcharged, according to the results of experiments, it occurs only when the lithium ions completely dedoped. For example, as to lithium cobalt oxides, lithium nickel oxides, and doped lithium cobalt oxides and lithium nickel oxides, when they are charged with 3C5A current, the experimental data show that only when the voltage is about 6.20 V the lithium ions completely dedoped, with releasing a lot of oxygen, and forming an insulator. As to lithium manganese oxides and doped lithium manganese oxides, the lithium ions completely dedoped under the same charge current when the cell potential is about 6.50 V. Generally, the specific energy of positive electrode active substance actually used in the present commercialized lithium ion cell is far less than the theoretical capacity thereof, and even if the charge cut-off voltage is elevated up to 5.8 V, the theoretical capacity cannot be achieved under the proviso that suitable formulation is used, thus, the cell is not overcharged. Therefore, the present method still enjoys satisfactory safety.

4. Besides the aforementioned factors, the self-discharge of cell, the selection of current collector, and the formation of passive film all affect the recycle life of lithium ion cell, while these factors mainly depend on the preparation of lithium ion cell. It is believable that if the optimal processes are used, the capacity, average operating voltage and specific energy can be greatly improved, while the recycle life and other properties of the cell are not affected.

   Hence, the present invention is to provide a novel method for effectively improving the specific energy and average operating voltage of secondary lithium ion cell or battery. Contrary to the prior art, the present method elevates the charge cut-off voltage to greater than 4.2 V but less than 5.8 V, and control the ratio of positive electrode material to negative electrode material of single lithium ion cell at 1:1.0 to 1:2.5 calculated by theoretical specific energy, so as to increase the efficacy of electrode active materials, to improve the capacity, energy density and output voltage of cell, and to maintain the performance of cell. For achieving the better effect, the charge cut-off voltage used in the present invention is preferably 4.3-5.2 V, and more preferably 4.3-4.8 V. In addition, the ratio of positive electrode material to negative electrode material of cell is 1:1.15 to 1:2.5 calculated by the theoretical capacity under the charge cut-off voltage of 4.2 V. The experiments showed that when the process parameters go beyond the aforesaid ranges, the properties of cell are deteriorated and unsuitable for use. When the ratio of positive electrode material to negative electrode material is less than 1.0 calculated by theoretical capacity, the recycle life of cell is excessively reduced, while when said ratio is greater than 2.5, the volume

efficiency of cell is notably reduced. Further, when the charge cut-off voltage is greater than 5.8 V, the cell has inferior properties and is unsuitable for use.

It can be seen that the capacity, specific energy and average operating voltage of secondary lithium ion cell can be greatly improved by elevating the charge cut-off voltage and by appropriately adjusting the ratio of positive electrode material to negative electrode material calculated by the theoretical capacity, while the recycle property of cell is not affected, which renders the lithium ion cell possess more commercial value and broader application range. Hence, it can also be seen that the present method further optimizes the utilization of positive electrode material, and thus is an economical method. The inventors believe that the method can still be used to positive and negative electrode materials having higher specific energy developed in future, and achieves the optimal effect.

In addition, it is worthy to be noted that the used in the present method is not such that the cell works in extreme conditions. After repetitive experiments, the inventor never found that the present method increased the probability of damage of cell. Hence, the present method is also a safe method.

Further, the present invention further provides a novel secondary cell or battery having improved specific energy and average operating voltage. Contrary to the prior art, the charge cut-off voltage of the single cell of said secondary cell or battery is greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material calculated by the theoretical capacity under the charge cut-off voltage of 4.2 V is 1:1.0 to 1:2.5. As compared to the prior secondary lithium ion cell or battery cell, the capacity, energy density and output voltage of the present secondary lithium ion cell or battery are greatly improved, while its recycle life is equivalent to that of the prior art cell. For achieving better effect, the aforesaid charge cut-off voltage used in the present invention is preferably in the range from 4.3 V to 5.2 V, more preferably in the range from 4.3 V to 4.8 V. In addition, the ratio of positive electrode material to negative electrode material of said singe lithium ion cell, which is calculated by the theoretical capacity under the charge cut-off voltage of 4.2 V, is 1:1.15 to 1:2.5. Experiments showed that when the process parameters go beyond the aforesaid ranges, the properties of cell are deteriorated and unsuitable for use. When the ratio of positive electrode material to negative electrode material is less than 1.0 calculated by theoretical capacity, the recycle life of cell is excessively reduced, while when said ratio is greater than 2.5, the volume efficiency of cell is notably reduced. Further, when the charge cut-off voltage is greater than 5.8 V, the cell has inferior properties and is unsuitable for use.
Moreover, it is important that the present method not only can be used to the secondary lithium ion cell or battery of the present invention, but also can be used to the secondary lithium ion cell or battery prepared according to the method of the prior art, such as the present commercialized secondary lithium ion cell or battery.

Without limitation, the following contents more concretely introduce the secondary lithium ion cell used in the present method. Generally, a secondary lithium ion cell comprises a positive electrode, a negative electrode, a non-aqueous electrolyte, and a separator the positive electrode and the negative electrode. The non-aqueous electrolyte can be obtained by dissolving lithium-containing metal salt, such as $LiPF_6$, as electrolyte into a non-aqueous solvent, such as ethylene carbonate or dimethyl carbonate. The separator can be insoluble in said non-aqueous solvent, and is a porous membrane made of polyethylene or polypropylene resin. The ratio of positive electrode material to negative electrode material is calculated by theoretical capacity under the charge cut-off voltage of 4.2 V.

Positive electrode

The positive electrode is prepared e.g., by dispersing positive electrode active material, conducting agent and binder in a suitable solvent to form a suspension, coating said suspension on a current collector, such as aluminum foil, then drying and pressing the coated current collector by rollers.

The positive electrode active substance used in the present invention is lithium-containing compound. Although the examples use lithium cobalt oxides (lithium cobalt composite oxides), lithium manganese oxides and lithium nickel oxides as positive electrode material, it is understood that the practice of the present invention is not limited to the specific properties of said lithium-containing composite oxides, rather a wide range of positive electrode active substance can be used in the present invention. The common feature of these oxides is that their specific energy increases with the increase of voltage, and the experiments (see the examples) prove that the capacity of cell is greatly elevated when the charge cut-off voltage is above 4.20 V, while the other properties of cell are not affected. The present invention can also be used to lithium ion cells having doped lithium-containing compound as positive electrode active material, such as various positive electrode active materials containing various oxides and sulfides, such as lithium cobalt composite oxides, lithium manganese composite oxides, lithium nickel composite oxides, lithium nickel cobalt composite oxides, lithium manganese cobalt composite oxides, and vanadium oxides. Among these positive electrode materials, lithium cobalt composite oxides (such as $LiCoO_2$), lithium manganese composite oxides (such as $LiMn_2O_4$), lithium nickel composite oxides (such as $LiNiO_2$), lithium nickel cobalt composite oxides (such as $LiNi_{1-x}Co_xO_2$), and lithium manganese cobalt composite oxides (such as $LiMn_xCo_{1-x}O_2$), which have higher cell voltage, are preferably used. In addition, the present invention can use conventional conducting agent and binder, and the mixture ratio for each components in the positive electrode active material can be those well known in the art.

Separator

The separator used in the present invention is a separator well known in the art. For example, it can be a non-woven fabric made of synthetic resin, polyethylene porous membrane or polypropylene porous membrane, and a material formed by like materials.

Negative electrode

The negative electrode is prepared e.g., by dispersing negative electrode active material, conducting agent and binder in a suitable solvent to form a suspension, coating said suspension on a current collector, such as copper foil, nickel foil or stainless steel foil, then drying and pressing the coated current collector by rollers.

The negative electrode active material used in the present invention is a carbonaceous or non-carbonaceous substance capable of doping and dedoping lithium ion, including, such as, lithium alloy (such as $Li_4Ti_5O_{12}$), metal oxide (such as amorphous tin oxide, WO_2 and MoO_2), TiS_2 and carbonaceous substance capable of absorbing and desorbing lithium ions, and especially, the carbonaceous substance is the desired negative electrode active material.

The carbonaceous substance used in the present invention includes: graphite, non-oriented graphite, coke, carbon fiber, spherical carbon, carbon sintered from resin, carbon grown in gas phase, and carbon nanometer tube. Since the negative electrode comprising the aforesaid specific carbon fiber or spherical carbon exhibits high charge efficiency, mesophase asphalt based carbon fiber or mesophase asphalt based spherical carbon is preferably used as the carbonaceous substance. The mesophase asphalt based carbon fiber or mesophase asphalt based spherical carbon can be obtained according to the conventional method.

Without any specific restriction, non-aqueous electrolytes and shells of the type well known in the art can be used in the present invention. For example, use can be made of non-aqueous electrolyte is a liquid non-aqueous electrolyte prepared by dissolving electrolyte in a non-aqueous solvent, a gel non-aqueous electrolyte prepared by mixing polymer, non-aqueous solvent and solute, or a solid polymer non-aqueous electrolyte, etc.

The cell structure can be a helical structure formed by wrapping anode and cathode with a separator inbetween, or a laminate structure formed by stacking anode and cathode with a separator inbetween, but the structure of cell is not limited to a certain shape, and it can be cylinder shape, prism shape, coin shape, button shape and so on.

Except voltage, all process parameters for charge and discharge are commonly used in the art.

Since the voltage used in the present invention is higher than the voltage currently used in the art, the necessary modification is made to the protecting circuit or relevant devices and equipments comprising said circuit which are used in the present method and for the present secondary lithium ion cell. The type and structure of the protecting circuit for said secondary lithium ion cell or battery shall not be specifically restricted, i.e., the well known structure can be used, provided that the first overcharging protection voltage is greater than 4.35 V, and the overcharge release voltage is greater than 4.15 V, preferably the first overcharging protection voltage is greater than 4.45 V, and the overcharge release voltage is greater than 4.25 V.

In addition, the electronic device of the present invention using a secondary lithium ion cell or battery as energy source shall not be specifically limited. The device can be a common structure, provided that said electronic device containing a single lithium ion cell having a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and the overcharge release voltage of greater than 4.25 V. The electronic device of the present invention includes: notebook type computer, PDA, electromotive bicycle, and electromotive automobile etc.

EXAMPLES

The present invention is described in detail hereinafter according to the results of specific experiments.

Preparation of single lithium ion cell

In one of examples of the present invention, the process for preparing the single lithium ion cell is described as follows.

Said single lithium ion cell uses copper foil as current collector of negative electrode, aluminum foil as current collector of positive electrode, lithium cobalt oxides as positive electrode active substance, and MCMB as negative electrode active substance. The type of cell is prismatic 653466. The lithium cobalt oxides is mixed with 7% PVDF as binder and 5% conductive carbon black, and then is added into NMP solvent in a ratio of 1:1. The negative electrode material is directly mixed with 10% PVDF as binder in a ratio of 1:1 to form a slurry. The positive electrode slurry is coated on the positive electrode current collector, and the negative electrode slurry is coated on the negative electrode current collector, and then they are dried and pressed, and treated by coating. The coating slurry for the positive electrode is prepared by dissolving a mixture of carbonaceous material and PVDF in an organic solvent, which is coated on the dried positive electrode. The coated positive electrode is pressed and baked again.

The dried positive electrode and negative electrode are connected to a lead, and

a separator made of PP is inserted between them. After being wrapped by a winder to form an assembly, and this assembly is mounted into a cell shell made of aluminum or steel material. The shell and the cover are soldered together by laser soldering. An electrolyte solution is injected into the cell under relative humidity less than 1.5%, wherein said electrolyte solution contains a mixture solvent of EC:DEC:DMC = 1:1:1, and an electrolyte of 1M $LiPF_6$. The cell is immediately sealed after the injection.

Example 1

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

Example 2

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

Example 3

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

Example 4

Several lithium ion cells of quadrate type 653466 are prepared according to the above method, and they each have a ratio of positive electrode material to negative electrode material of 1:1.0, 1:1.05, 1:1.1, 1:1.15, 1:1.2, 1:1.25 and 1:1.3. After formation and test using an charge cut-off voltage of 4.40 V, these cells have an arithmetic mean capacity of 1302 mAh, a weight specific energy of 123 Wh/kg, an average operating voltage of 3.80 V, and maintain 83.93% of capacity

after 400 recycles.

Example 5

Lithium ion cells of quadrate type 653466 are prepared according to the above method, and it has a ratio of positive electrode material to negative electrode material of 1:1.45. After formation and test using an charge cut-off voltage of 4.45 V, said cell has a capacity of 1365 mAh, a weight specific energy of 129 Wh/kg, an average operating voltage of 3.85 V, and maintain 84.56% of capacity after 400 recycles.

Example 6

Lithium ion cells of quadrate type 653466 are prepared according to the above method, and it has a ratio of positive electrode material to negative electrode material of 1:1.60. After formation and test using an charge cut-off voltage of 4.60 V, said cell has a capacity of 1692 mAh, a weight specific energy of 165 Wh/kg, an average operating voltage of 3.9 V, and maintain 85.13% of capacity after 400 recycles.

Example 7

Lithium ion cells of quadrate type 653466 are prepared according to the above method, and it has the ratio of positive electrode material to negative electrode material of 1:1.7. After formation and test using an charge cut-off voltage of 4.80 V, said cell has a capacity of 1824 mAh, a weight specific energy of 178 Wh/kg, an average operating voltage of 3.9 V, and maintain 83.92% of capacity after 400 recycles.

Example 8

Lithium ion cells of quadrate type 653466 are prepared according to the above method, and it has the ratio of positive electrode material to negative electrode material of 1:1.9, wherein the substance A having high decomposition potential is added, or the electrolyte solution B having high decomposition potential is used. After formation and test using an charge cut-off voltage of 5.00 V, said cell has a capacity of 1894 mAh, a weight specific energy of 186 Wh/kg, an average operating voltage of 3.93 V, and maintain 81.23% of capacity after 400 recycles.

Example 9

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.2. After formation and test using an charge cut-off voltage of 5.20 V, said cell has a capacity of 1962 mAh, a weight specific

energy of 194 Wh/kg, an average operating voltage of 3.96 V, and maintain 81.19% of capacity after 400 recycles.

Example 10

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.3. After formation and test using an charge cut-off voltage of 5.40 V, said cell has a capacity of 1968 mAh, a weight specific energy of 195 Wh/kg, an average operating voltage of 3.96 V, and maintain 81.19% of capacity after 400 recycles.

Example 11

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.4. After formation and test using an charge cut-off voltage of 5.60 V, said cell has a capacity of 1970 mAh, a weight specific energy of 195 Wh/kg, an average operating voltage of 3.96 V, and maintain 79.97% of capacity after 400 recycles.

Example 12

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.5. After formation and test using an charge cut-off voltage of 5.80 V, said cell has a capacity of 1972 mAh, a weight specific energy of 195 Wh/kg, an average operating voltage of 3.96 V, and maintain 78.82% of capacity after 400 recycles.

Example 13

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.6. After formation and test using an charge cut-off voltage of 5.90 V, said cell has a capacity of 1565 mAh, and maintain 12.31% of capacity after 15 cycles.

It can be seen from the above examples that when the charge voltage is elevated above 4.2 V, the capacity, operating voltage and weight specific energy increase with the elevation of the charge voltage; and when the charge voltage is elevated above 4.45 V, the capacity, operating voltage and weight specific energy

continuously further increase with the elevation of the charge voltage and of the ratio of positive electrode material to negative electrode material; but when the charge voltage is greater than 5.8 V, the properties of cell decrease.

Examples 14-18

Using lithium manganese oxide as positive electrode active material, Lithium ion cells are prepared according to the aforesaid method, wherein the positive electrode slurry consists of 4 g lithium manganese oxide, 0.6 g carbon black, 0.32 g PVDF, and 4.92 g NMP, and the negative electrode slurry consists of 2.6 g MCMB, 0.26 g PVDF, and 3.0 g NMP. The cell is a quadrate type 653466 lithium ion cell. The data of experiments are depicted in Table 2.

Table 2

Example	Charge cut-off voltage (V)	Processing change	Recycle property	Capacity (mAh)
14	4.20	--	Maintaining 84.23% after 400 recycles	375
15	4.30	--	Maintaining 85.12% after 400 recycles	405
16	4.60	The ratio of positive electrode material to negative electrode material is 1:1.6.	Maintaining 83.45% after 400 recycles	575
17	5.80	The ratio of positive electrode material to negative electrode material is 1:2.5, and substance A is added into the electrolyte solution.	Maintaining 82.83% after 400 recycles	567
18	5.90	The ratio of positive electrode material to negative electrode material is 1:2.7, and substance A is added into the electrolyte solution.	Maintaining 54.23% after 30 cycles	312

Examples 14-18 show that when using lithium manganese oxide as positive electrode active material, the cells obtain the results similar to that of examples 1-13. Namely, when the charge voltage is elevated above 4.2 V, the capacity, operating voltage and weight specific energy increase with the elevation of the charge voltage; and when the charge voltage is elevated above 4.45 V, the capacity, operating voltage and weight specific energy continuously increase with the elevation of the charge voltage and of the ratio of positive electrode material to negative electrode material; but when the charge voltage is greater than 5.8 V, the properties of cell decrease.

Examples 19-23

Using lithium nickel oxide as positive electrode active material, Secondary lithium ion cells are prepared according to the aforesaid method for preparing the lithium

ion cells using lithium cobalt oxide as positive electrode active material, wherein the positive electrode slurry consists of 4 g lithium nickel oxide, 0.2 g carbon black, 0.2 g PVDF, and 4.80 g NMP, and the negative electrode slurry consists of 3.5 g MCMB, 0.35 g PVDF, and 4.0 g NMP. The cell is a quadrate type 063048 lithium ion cell. The data of experiments are depicted in Table 3.

Table 3

Example	Charge cut-off voltage (V)	Processing change	Recycle property	Capacity (mAh)
19	4.20	--	Maintaining 81.23% after 400 recycles	610
20	4.30	--	Maintaining 80.72% after 400 recycles	675
21	4.60	The ratio of positive electrode material to negative electrode material is 1:1.6.	Maintaining 78.32% after 400 recycles	912
22	5.80	The ratio of positive electrode material to negative electrode material is 1:2.5, and substance A is added into the electrolyte solution.	Maintaining 75.83% after 400 recycles	879
23	5.90	The ratio of positive electrode material to negative electrode material is 1:2.7, and substance A is added into the electrolyte solution.	Maintaining 47.53% after 50 cycles	796

Examples 19-23 show that when using lithium nickel oxide as positive electrode active material, the cells obtain the results similar to those of examples 1-16. Namely, when the charge voltage is elevated above 4.2 V, the capacity, operating voltage and weight specific energy increase with the elevation of the charge voltage; and when the charge voltage is elevated above 4.45 V, the capacity, operating voltage and weight specific energy continuously increase with the elevation of the charge voltage and of the ratio of positive electrode material to negative electrode material; but when the charge voltage is greater than 5.8 V, the properties of cell decrease.

Examples 24-28

Using cobalt-doping lithium nickel oxide as positive electrode active material, a

secondary lithium ion cell is prepared according to the aforesaid method for preparing the secondary lithium ion cells using lithium cobalt oxide as positive electrode active material, wherein the positive electrode slurry consists of 4 g lithium nickel oxide, 0.2 g carbon black, 0.2 g PVDF, and 4.80 g NMP, and the negative electrode slurry consists of 3.5 g MCMB, 0.35 g PVDF, and 4.0 g NMP. The cell is a quadrate type 063048 lithium ion cell. The data of experiments are depicted in Table 4.

Table 4

Example	Charge cut-off voltage (V)	Processing change	Recycle property	Capacity (mAh)
24	4.20	--	Maintaining 81.23% after 400 recycles	623
25	4.30	--	Maintaining 80.72% after 400 recycles	682
26	4.60	The ratio of positive electrode material to negative electrode material is 1:1.6.	Maintaining 78.32% after 400 recycles	934
27	5.80	The ratio of positive electrode material to negative electrode material is 1:2.5, and substance A is added into the electrolyte solution.	Maintaining 75.83% after 400 recycles	919
28	5.90	The ratio of positive electrode material to negative electrode material is 1:2.7, and substance A is added into the electrolyte solution.	Maintaining 39.53% after 50 cycles	697

Examples 24-28 show that when using cobalt-doping lithium nickel oxide as positive electrode active material, the cells obtain the results similar to those of examples 1-21. Namely, when the charge voltage is elevated above 4.2 V, the capacity, operating voltage and weight specific energy increase with the elevation of the charge voltage; and when the charge voltage is elevated above 4.45 V, the capacity, operating voltage and weight specific energy continuously increase with the elevation of the charge voltage and of the ratio of positive electrode material to negative electrode material; but when the charge voltage is greater than 5.8 V, the properties of cell decrease. In the meantime, these results indicate that the present method is not limited to some specific lithium-containing composite oxides as positive electrode material, but can be widely used in various

secondary lithium ion cells.

The present method can be used in the production of lithium ion cell and for improvement of relevant products in the following aspects.

1. After adjustment of ratio of positive electrode material to negative electrode material so that the single lithium ion cell obtains the optimal capacity calculated by theoretical specific energy, a secondary lithium ion cell having high capacity and excellent recycle property can be obtained by controlling the charge cut-off voltage within a range from 4.2 V to 5.8 V during the formation and test of the cell. The merits of this method lie in that the specific energy and average operating voltage are greatly improved without substantially increasing the cost and simultaneously with the effects that the original formation process should achieve. Thus, as to the manufacturer of lithium ion cell, the profit margin and the competitiveness of enterprise are improved; and as to the products using lithium ion cells, their performances are improved with the increase of capacity and average operating voltage of the lithium ion cells.

2. The protecting circuit of single secondary lithium ion cell based on the present invention possesses an overcharge release voltage of greater than 4.15 V, and an overcharge first protection voltage of greater than 4.35 V.

3. The single lithium ion cell prepared according to the present invention can combine with the aforesaid protecting circuit having the technical features of the present invention and form a secondary lithium ion cell or battery.

4. The protecting circuit having the technical features of the present invention can be used in a mobile electronic device and product having a secondary lithium ion cell or battery as energy source.

The technology of the present invention possesses a great commercial value for improving the capacity, average operating voltage and specific energy of the secondary lithium ion cell, and makes a certain contribution to the research of the basic theory of lithium ion cell. It is believable that the present technology could improve the development of the whole secondary lithium ion cell industry.

CLAIMS:

1. A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that the charge cut-off voltage of the singe cell is greater than 4.2 V but less than 5.8 V, preferably within a range from 4.3 V to 5.2 V, and more preferably within a range from 4.3 V to 4.8 V; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.

2. A secondary lithium ion cell or battery, characterized in that the single secondary lithium ion cell has an charge cut-off voltage of greater than 4.2 V but less than 5.8 V, preferably within a range from 4.3 V to 5.2 V, and more preferably within a range from 4.3 V to 4.8 V; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by theoretic capacity.

3. A secondary lithium ion cell of battery according to claim 2, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V.

4. A protecting circuit for the secondary lithium ion cell or battery according to claims 2 or 3, characterized in that the single lithium ion cell of said protecting circuit has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V.

5. An electronic device using a secondary lithium ion cell or battery as energy source, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V.

ABSTRACT

The present invention provides a new method for improving capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery. This method is achieved by means of properly adjusting the ratio between a positive material and negative material, which is calculated by theoretical specific energy, and properly increasing charge cut-off voltage. The present method can greatly increasing specific energy and average operating voltage of a secondary lithium ion cell without influence on recycle property of the cell. The present invention also provides a secondary lithium ion cell or battery practicing the method, a protecting circuit adapted for the secondary lithium ion cell or battery, a electronic device using said protecting circuit and said secondary lithium ion cell or battery.

Electronic Acknowledgement Receipt	
EFS ID:	4227473
Application Number:	10491134
International Application Number:	
Confirmation Number:	7003
Title of Invention:	Secondary lithium ion cell or battery, and protecting circuit, electronic device, and charging device of the same
First Named Inventor/Applicant Name:	Xiaoping Ren
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Xiaoping REN et al.
Title:	SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME
Appl. No.:	10/491,134
International Filing Date:	09/28/2002
371(c) Date:	05/06/2004
Examiner:	Muhammad S. Siddiquee
Art Unit:	1795
Confirmation Number:	7003

AMENDMENT AND REPLY UNDER 37 CFR 1.111

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

Sir:

This communication is responsive to the Non-Final Office Action dated July 21, 2008, concerning the above-referenced patent application.

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this document.

Remarks/Arguments begin on page 5 of this document.

Please amend the application as follows:

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that the charge cut-off voltage of the ~~singe~~ single cell is greater than 4.2 V but less than 5.8 V; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, 5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.

2. (Currently Amended) A method according to claim 1, characterized in that the charge cut-off voltage of the ~~singe~~ single cell is within a range from 4.3 V to 5.2 V.

3. (Currently Amended) A method according to claim 1, characterized in that the charge cut-off voltage of the ~~singe~~ single cell is within a range from 4.3 V to 4.8 V.

4. (Previously Presented) A method according to claim 1, characterized in that the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.15 to 1:2.5.

5. (Previously Presented) A secondary lithium ion cell or battery, characterized in that the single secondary lithium ion cell has a charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, as calculated by the theoretic capacity with the charge cut-off voltage set at 4.2 V.

6. (Previously Presented) A secondary lithium ion cell or battery according to claim 5, characterized in that the single secondary lithium ion cell has a charge cut-off voltage within a range from 4.3 V to 5.2 V.

7. (Previously Presented) A secondary lithium ion cell or battery according to claim 5, characterized in that the single secondary lithium ion cell has a charge cut-off voltage within a range from 4.3 V to 4.8. V.

8. (Previously Presented) A secondary lithium ion cell or battery according to claim 5, characterized in that the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.15 to 1:2.5.

9. (Previously Presented) A secondary lithium ion cell or battery according to claim 5, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V.

10. (Previously Presented) A secondary lithium ion cell or battery according to claim 9, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

11. (Withdrawn) A protecting circuit for the secondary lithium ion cell or battery according to claim 5, characterized in that the single lithium ion cell of said protecting circuit has a first overcharge protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V.

12. (Withdrawn) A protecting circuit according to claim 11, characterized in that the single lithium ion cell of said protecting circuit has a first overcharge protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

13. (Withdrawn) An electronic device using a secondary lithium ion cell or battery as energy source, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge protection release voltage of greater than 4.15 V.

14. (Withdrawn) An electronic device according to claim 13, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

15. (Withdrawn) A charging device for a secondary lithium ion cell or battery, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range of greater than 4.3 V but less than 5.8 V.

16. (Withdrawn) A charging device according to claim 15, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range from 4.3 V to 5.2 V.

17. (Withdrawn) A charging device according to claim 15, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range from 4.3 V to 4.8 V.

REMARKS

Applicant thanks the Examiner for a thorough examination of the present application, but respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow. Claims 1-17 are currently pending in this application (with claims 11-17 being withdrawn from consideration). Claims 1-3 have been amended to correct a typographical error.

In the outstanding Office Action of July 21, 2008, the Examiner rejected claims 1-10 as being anticipated by U.S. Patent No. 5,260,148 to Idota (Idota). Applicant respectfully traverses this rejection for at least the reasons set forth below.

The Examiner asserted that Idota teaches all of the elements of independent claims 1 and 5 except for the charge cut-off voltage being greater than 4.2V but less than 5.8V. In order to cure this deficiency, the Examiner cited *In re Robertson*, 49 USPQ2d 1949 (1999), and asserted that "it is the position of the Examiner that such properties (capacity, average operating voltage, specific energy) are inherent, given that both Idota and the present application utilize the same anode active material and cathode active material." (*See*, page 3 of Office Action). Applicant respectfully disagrees with the Examiner's position.

In re Robertson states that "[a] reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference." (Emphasis added). Applicant respectfully submits that the Examiner's reliance on this case law is misplaced inasmuch as a charge cut-off voltage being greater than 4.2V but less than 5.8V it is not necessarily present in the battery of Idota. In fact, such a voltage range is not even hinted at in the disclosure of Idota. As discussed throughout the present application, and as is well known in the lithium ion battery technology, the charge cut-off voltage for lithium ion cells is no more than 4.2V. This is well accepted as a technical requirement in the industry and in the manufacturing of lithium ion cells. This point is demonstrated by the fact that lithium ion batteries in markets around the world are manufactured under this technical requirement (*i.e.*, no more than 4.2V). As such, Applicant submits that it is not inherent that the cell of Idota has a charge cut-off voltage being greater than 4.2V but less than 5.8V

Furthermore, there are numerous published documents which indicate the negatives associated with raising the charge cut-off voltage above 4.2V. For example, and as discussed throughout the background section of the present application, various publications and research programs have found that increasing the charge cut-off voltage above 4.2V changes the structure of the positive electrode material and decreases the cycle properties of the lithium ion cells. Moreover, raising the charge cut-off voltage decomposes the electrolyte solutions. As such, Applicant submits that the Examiner's inherency arguments contradicts the research conducted in the relevant art.

Thus, in sum, Applicant submits that the Examiner's inherency assertion with regard to the battery of Idota being greater than 4.2V but less than 5.8V is incorrect and is not supported by any written evidence or the knowledge of one skilled in the art. The present invention is a breakthrough in improving the capacity of lithium ion cells that has never been positively mentioned or even suggested, let alone recommended. For at least these reasons, Applicant respectfully requests withdrawal of the rejection of claims 1 and 5 as being anticipated by Idota. In addition, Applicant requests withdrawal of the rejection of claims 2-4 and 6-10, since each of these claims are directly or indirectly dependent upon independent claims 1 and 5.

Claims 1-10 were also rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent Publication No. 2003/0113613 to Takeuchi et al. (Takeuchi). In addition, claims 9 and 10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Takeuchi in view of U.S. Patent No. 6,558,848 to Kobayshi et al. (Kobayashi). Applicant respectfully traverse these rejections for at least the reasons set forth below.

Applicant respectfully submits that the Takeuchi reference is not prior art to the present application and, therefore, both rejections based on the Takeuchi reference are moot.

At best, the effective filing date of portions of the Takeuchi reference is December 17, 2001 (based on Provisional Application No. 60/341/552). However, the present application has a foreign priority date of September 28, 2001 based on the Chinese Application No. 011416157. Since September 28, 2001 is well before December 17, 2001, Applicant respectfully submits that the Takeuchi reference is not prior art to the present application.

Furthermore, if necessary, Applicant expressly reserves the right to file a certified English translation of this document to perfect this date.

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested. The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by the credit card payment instructions in EFS-Web being incorrect or absent, resulting in a rejected or incorrect credit card transaction, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date 10/21/08

By _____

FOLEY & LARDNER LLP
Customer Number: 22428
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Electronic Acknowledgement Receipt	
EFS ID:	4148609
Application Number:	10491134
International Application Number:	
Confirmation Number:	7003
Title of Invention:	Secondary lithium ion cell or battery, and protecting circuit, electronic device, and charging device of the same
First Named Inventor/Applicant Name:	Xiaoping Ren
Customer Number:	22428
Filer:	Mohammad A. Haq/Linda Novak
Filer Authorized By:	Mohammad A. Haq
Attorney Docket Number:	042787-0106
Receipt Date:	21-OCT-2008
Filing Date:	06-MAY-2004
Time Stamp:	15:58:45
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Response.pdf	249875 b6d6c311516caee5e6a7db2d3a37d4ba7c593074	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	4
	Applicant Arguments/Remarks Made in an Amendment	5	7
Warnings:			
Information:			
	Total Files Size (in bytes):	249875	

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.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a 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.

<u>National Stage of an International Application under 35 U.S.C. 371</u>
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.

<u>New International Application Filed with the USPTO as a Receiving Office</u>
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.

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 10/491,134	Filing Date 05/06/2004	☐ To be Mailed

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	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 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			TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	10/21/2008	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	* 17	Minus	** 20	= 0	X $26 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $110 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

		(Column 1)		(Column 2)	(Column 3)					
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	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 number found in the appropriate box in column 1.

Legal Instrument Examiner:
/SANDRA F. GARNETT/

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.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/491,134	05/06/2004	Xiaoping Ren	042787-0106	7003

22428 7590 07/21/2008
FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

EXAMINER	
SIDDIQUEE, MUHAMMAD S	
ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
07/21/2008	PAPER

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.

Office Action Summary	Application No.	Applicant(s)	
	10/491,134	REN ET AL.	
	Examiner	Art Unit	
	MUHAMMAD SIDDIQUEE	1795	

-- 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* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *20 June 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ 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

4)☒ Claim(s) *1-17* is/are pending in the application.

4a) Of the above claim(s) *11-17* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

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

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☒ All b)☐ Some * c)☐ None of:

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)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *10/21/2004, 7/21/2005*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of Group 1 drawn to a secondary lithium ion battery and a method for improving the capacity average operating voltage and specific energy of the same in the reply filed on 6/20/2008 is acknowledged. Claims 1-10 are examined on the merits.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-10 rejected under 35 U.S.C. 102(b) as being anticipated by Idota (US 5,260,148).

Regarding claims 1-4, Idota discloses a lithium secondary battery comprising an anode and a cathode where the ratio of the equivalent amount of the anode (negative electrode) active material to that of the cathode (positive electrode) active material be larger than 1 (i.e., the amount of the anode active material is more than equivalent to the cathode active material). The ratio thereof is more preferably from 1.1 to 5, most preferably from 1.1 to 3.5. [column 3, lines 14-19]. The method for improving the

capacity, average operating voltage and specific energy of a secondary lithium ion battery is inherent. Idota does not specifically disclose battery is capable of being charged to between 4.2 volts to 5.8 volts. However, it is the position of the examiner that such properties (capacity, average operating voltage, specific energy) are inherent, given that both Idota and the present application utilize the same anode active material and cathode active material. *A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. In re Robertson, 49 USPQ2d 1949 (1999).*

Regarding claims 5-10, Idota discloses a lithium secondary battery comprising an anode and a cathode where the ratio of the equivalent amount of the anode (negative electrode) active material to that of the cathode (positive electrode) active material is larger than 1 (i.e., the amount of the anode active material is more than equivalent to the cathode active material). The ratio thereof is more preferably from 1.1 to 5, most preferably from 1.1 to 3.5. [column 3, lines 14-19]. Idota does not specifically disclose battery is capable of being charged to between 4.2 volts to 5.8 volts. However, it is the position of the examiner that such properties (capacity, average operating voltage, specific energy) are inherent, given that both Idota and the present application utilize the same anode active material and cathode active material. *A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. In re Robertson, 49 USPQ2d 1949 (1999).*

4. Claims 1-10 are rejected under 35 U.S.C. 102(e) as being anticipated by Takeuchi et al (US 2003/0113613 A1).

Regarding claims 1-4, Takeuchi discloses a lithium secondary battery comprising an anode (negative electrode) active material and a cathode (positive electrode) active material where the ratio of the cathode active material to the anode material of from about 1.35 to about 2.25. This significantly improves the energy density of the secondary cell by increasing the charge voltage to at least 4.4V [Abstract; Fig. 1; paragraph 0028, 0030, and 0034]. The method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion battery is inherent.

Regarding claims 5-10, Takeuchi discloses a lithium secondary battery comprising an anode (negative electrode) active material and a cathode (positive electrode) active material where the ratio of the cathode active material to the anode material of from about 1.35 to about 2.25. This significantly improves the energy density of the secondary cell by increasing the charge voltage to at least 4.4V [Abstract; Fig. 1; paragraph 0028, 0030, and 0034].

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) 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.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 9-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeuchi et al (US 2003/0113613 A1) as applied to claim 5 above, and further in view of Kobayashi et al (US 6,558,848 B1).

Regarding claims 9-10, overcharging protection release voltage is inherent in the battery of Takeuchi, however, if the applicants argue, Kobayashi discloses secondary battery where in the case of lithium secondary cells, the charge cut-off voltage was set at 4.5V and discharge cut-off voltage at 4.5V. Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to utilize cut-off

voltage as taught by Kobayashi in the battery of Takeuchi in order to have an efficient battery.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MUHAMMAD SIDDIQUEE whose telephone number is (571)270-3719. The examiner can normally be reached on Monday-Thursday, 7:30 am to 4:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MSS

/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1795

Notice of References Cited	Application/Control No. 10/491,134	Applicant(s)/Patent Under Reexamination REN ET AL.	
	Examiner MUHAMMAD SIDDIQUEE	Art Unit 1795	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-5,260,148	11-1993	Idota, Yoshio	429/307
*	B	US-2003/0113613 A1	06-2003	Takeuchi et al.	429/60
*	C	US-6,558,848 B1	05-2003	Kobayashi et al.	429/241
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

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

NON-PATENT DOCUMENTS

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	V	
	W	
	X	

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

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CONFIRMATION NO. 7003

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
10/491,134	05/06/2004 RULE	204	1795	042787-0106

APPLICANTS

Xiaoping Ren, Beijing, CHINA;
Jie Sun, Beijing, CHINA;

MSS

**** CONTINUING DATA ***************************

This application is a 371 of PCT/CN02/00696 09/28/2002

**** FOREIGN APPLICATIONS *************************** MSS

CHINA 011416157 09/28/2001

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Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☑ Yes ☐ No	☑ Yes ☐ No	/MUHAMMAD S SIDDIQUEE/ Examiner's Signature	☐ Initials	CHINA	0	17	4

ADDRESS

FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007
UNITED STATES

TITLE

Secondary lithium ion cell or battery, and protecting circuit, electronic device, and charging device of the same

FILING FEE RECEIVED		
648	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

BIB (Rev. 05/07).

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/21/2008	07/12/2008							
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	17	÷	N							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

SEARCHED			
Class	Subclass	Date	Examiner
429	60, 231.95	7/11/2008	MSS

SEARCH NOTES		
Search Notes	Date	Examiner
Consulted with Gregg Cantelmo in Art unit 1795	7/11/2008	MSS
Searched for Inventor in EAST and PALM (assignee info is not avaiable in PALM)	7/11/2008	MSS
Searched USPAT, US-PGPUB, EPO, JPO, DERWENT	7/11/2008	MSS
Class 429/60, 231.95 was limited by text, see EAST search history.	7/11/2008	MSS

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	6	US-1135103-$.DID. OR US-1185860-$.DID. OR JP-2000270491-$.DID.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2008/07/09 11:57
S2	2	"5604418".pn.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	NEAR	ON	2008/07/09 11:59
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S19	12169	S18 not (battery or celectrochemical cell)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:22
S20	5368	S18 not S19	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:22
S21	2857	(positive electrode or negative electrode or anode or cathode) near5 material with ratio	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:23
S22	724	S21 not (battery or celectrochemical cell)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 18:23
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S29	924	(ratio with positive adj electrode with negative adj electrode with material) or (ratio with anode with cathode with material)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 19:31

S30	97	(ratio near5 positive adj electrode near5 negative adj electrode near5 material) or (ratio near5 anode near5 cathode near5 material)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 19:33
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S33	228	(overcharg$4 near5 protect$4 near5 voltage)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:53
S34	0	S30 and (overcharg$4 near5 protect$4 near5 voltage)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:54
S35	0	S30 and S33	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:54
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S37	5	S30 and (overcharg$4 near5 voltage)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:57
S38	4	S26 and (overcharg$4 near5 voltage)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 20:57
S39	44	S26 and (charg$4 near5 volt$4) and dischard$4 near5 volt$4	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 21:01
S40	38	S26 and((charg$4 near5 volt$4) with (dischard$4 near5 volt$4))	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/11 21:01
S41	2	09/768298	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 09:08
S42	1	10/320319	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 09:13
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S44	15	overcharge near5 releas $4 near5 volt$4	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 12:50
S45	146	429/60.ccls.	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:17
S46	97	S45 and (ratio near5 positive adj electrode near5 negative adj electrode near5 material) or (ratio near5 anode near5 cathode near5 material)	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:18

S47	116	429/2.ccls.	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:20
S48	1737	429/231.95.ccls.	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:20
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S50	22	(SUN-JIE or REN-XIAOPING).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT	NEAR	ON	2008/07/12 13:23
S51	1	S50 and (charg$4 near5 volt$4) and discharg$4 near5 volt$4	US-PGPUB; USPAT; USOCR	NEAR	ON	2008/07/12 13:24

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OIPE JC25 JUL 21 2005 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Xiaoping REN et al.

Title: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

Appl. No.: 10/491,134

Filing Date: 05/06/2004

Examiner: Melissa J. Austin

Art Unit: 1745

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR §1.56

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

Sir:

Submitted herewith on Form PTO/SB/08 is a listing of documents known to Applicants in order to comply with Applicants' duty of disclosure pursuant to 37 CFR §1.56.

A copy of each non-U.S. patent document and each non-patent document is being submitted to comply with the provisions of 37 CFR §1.97 and §1.98.

The submission of any document herewith, which is not a statutory bar, is not intended as an admission that such document constitutes prior art against the claims of the present application or that such document is considered material to patentability as defined in 37 CFR §1.56(b). Applicants do not waive any rights to take any action which would be appropriate to antedate or otherwise remove as a competent reference any document which is determined to be a *prima facie* art reference against the claims of the present application.

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The listed documents are being submitted in compliance with 37 CFR §1.97(b), before the mailing date of the first Office Action on the merits.

RELEVANCE OF EACH DOCUMENT

A partial English language translation of the foreign-language document entitled *"Materials for New Energy"*, is submitted herewith. An English translation of the complete document is not readily available. However, the absence of such translation does not relieve the PTO from its duty to consider the submitted foreign language document (37 CFR §1.98 and MPEP §609).

Applicants respectfully request that each listed document be considered by the Examiner and be made of record in the present application and that an initialed copy of Form PTO/SB/08 be returned in accordance with MPEP §609.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 CFR §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

Respectfully submitted,

Date 21 July 2005

By S. A. Bent

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

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Date Submitted: July 21, 2005

(use as many sheets as necessary)

Sheet	1	of	1

Complete if Known	
Application Number	10/491,134
Filing Date	05/06/2004
First Named Inventor	Xiaoping REN
Group Art Unit	1745
Examiner Name	Melissa J. Austin
Attorney Docket Number	042787-0106

OIPE JC25 JUL 21 2005 PATENT & TRADEMARK OFFICE

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	U.S. Patent Document Number	U.S. Patent Document Kind Code[2] (*if known*)	Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Office[3]	Number[4]	Kind Code[5] (*if known*)	Name of Patentee or Applicant of Cited Documents	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]
/M.S./	B1	K. MIZUSHIMA et al., "Li_xCo_2 (0<x<1): A NEW CATHODE MATERIAL FOR BATTERIES OF HIGH ENERGY DENSITY ", Mat. Res. Bull., Vol. 15, pp. 783-789 1980.	
/M.S./	B2	G. PISTOIA et al., 'Synthesis of Mn spinels from different polymorphs of MnO_2" Journal of Power Sources, 56 (1995) 37-43.	
/M.S./	B3	Lei Yongquan, "Materials for New Energy", 2000, pg. 136.	

Examiner Signature	/Muhammad Siddiquee/	Date Considered	07/14/2008

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

[1] Unique citation designation number. [2]See attached Kinds of U.S. Patent Documents. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

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OCT 2 1 2004
PATENT & TRADEMARK OFFICE

JTV

Atty. Dkt. No. 042787-0106

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Xiaoping REN et al.

Title: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

Appl. No.: 10/491,134

Filing Date: May 6, 2004

Examiner: Melissa J. Austin

Art Unit: 1745

INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR §1.56

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

Sir:

Submitted herewith on Form PTO/SB/08 is a listing of documents known to Applicants in order to comply with Applicants' duty of disclosure pursuant to 37 CFR §1.56. A copy of each listed document is being submitted to comply with the provisions of 37 CFR §1.97 and §1.98.

The submission of any document herewith, which is not a statutory bar, is not intended as an admission that such document constitutes prior art against the claims of the present application or that such document is considered material to patentability as defined in 37 CFR §1.56(b). Applicants do not waive any rights to take any action which would be appropriate to antedate or otherwise remove as a competent reference any document which is determined to be a *prima facie* art reference against the claims of the present application.

TIMING OF THE DISCLOSURE

The listed documents are being submitted in compliance with 37 CFR §1.97(b), before the mailing date of the first Office Action on the merits.

The PTO did not receive the following listed item(s) References marked as Asterisk cc *11

RELEVANCE OF EACH DOCUMENT

Any document listed on the attached PTO/SB/08 was cited as being relevant during the prosecution of the corresponding International application. A copy of the International Search Report is attached setting forth the portion of each document considered relevant by the examiner. A copy of the documents cited in the Search Report are not being submitted herewith. An English-language counterpart of the foreign-language documents has not been provided. The absence of a translation or an English-language counterpart document does not relieve the PTO from its duty to consider any submitted document (37 CFR §1.98 and MPEP§609).

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Respectfully submitted,

Date 21 October 2004

By S. A. Bent

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

OIPE JC25 OCT 21 2004 PATENT & TRADEMARK OFFICE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Date Submitted: October 21, 2004

(use as many sheets as necessary)

Sheet 1 of 1

Complete if Known	
Application Number	10/491,134
Filing Date	05/06/2004
First Named Inventor	Xiaoping REN
Group Art Unit	1745
Examiner Name	Melissa J. Austin
Attorney Docket Number	042787-0106

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	U.S. Patent Document Number	U.S. Patent Document Kind Code[2] (if known)	Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
/M.S./	A1	5,604,418		Alcatel Alsthom Compagnie Generale	2/18/1997	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Office[3]	Number[4]	Kind Code[5] (if known)	Name of Patentee or Applicant of Cited Documents	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
/M.S./	A2		CN 1135103 A			11/06/1996		
/M.S./	A3		CN 1185860 A			6/24/1998		
/M.S./	A4		JP 2000-270491 A			9/29/2000		

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]
/M.S./	A5	International Search Report	

Examiner Signature	/Muhammad Siddiquee/	Date Considered	07/14/2008

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

[1] Unique citation designation number. [2]See attached Kinds of U.S. Patent Documents. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, 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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Xiaoping REN et al.
Title:	*SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME*
Appl. No.:	10/491,134
International Filing Date:	09/28/2002
371(c) Date:	05/06/2004
Examiner:	Muhammad S. Siddiquee
Art Unit:	1795
Confirmation Number:	7003

RESPONSE TO RESTRICTION REQUIREMENT

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

Sir:

In response to the restriction requirement set forth in the Office Action mailed May 23, 2008, Applicant hereby provisionally elects Group I, Claims 1-10 drawn to a secondary lithium ion battery and a method for improving the capacity average operating voltage and specific energy of the same for examination on the merits. This election is made without traverse.

Applicants reserve the right to file divisional applications directed to the subject matter of the non-elected claims.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by the credit card payment instructions in EFS-Web being incorrect or absent, resulting in a rejected or incorrect credit card transaction, the Commissioner is authorized

to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extension fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date 20 June 2008 By S. A. Bent

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

Electronic Acknowledgement Receipt	
EFS ID:	3495804
Application Number:	10491134
International Application Number:	
Confirmation Number:	7003
Title of Invention:	Secondary lithium ion cell or battery, and protecting circuit, electronic device, and charging device of the same
First Named Inventor/Applicant Name:	Xiaoping Ren
Customer Number:	22428
Filer:	Stephen A. Bent/Barbara Beavers
Filer Authorized By:	Stephen A. Bent
Attorney Docket Number:	042787-0106
Receipt Date:	20-JUN-2008
Filing Date:	06-MAY-2004
Time Stamp:	17:52:47
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
1	Response to Election / Restriction Filed	restrictionresponse.pdf	40396 4a0ba2b7c163d9bafe3a6db590691f413e82e447	no	2
Warnings:					
Information:					

Total Files Size (in bytes):	40396

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 a 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.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/491,134	05/06/2004	Xiaoping Ren	042787-0106	7003

22428 7590 05/23/2008

FOLEY AND LARDNER LLP
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

EXAMINER	
SIDDIQUEE, MUHAMMAD S	
ART UNIT	PAPER NUMBER
1795	
MAIL DATE	DELIVERY MODE
05/23/2008	PAPER

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.

Office Action Summary	Application No.	Applicant(s)	
	10/491,134	REN ET AL.	
	Examiner	Art Unit	
	MUHAMMAD SIDDIQUEE	1795	

-- 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 *1* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *06 May 2004*.

2a)☐ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ 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

4)☒ Claim(s) *1-17* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☐ Claim(s) _____ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) *1-17* are subject to restriction and/or election requirement.

Application Papers

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

10)☐ The drawing(s) filed on _____ 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).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

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).

a)☐ All b)☐ Some * c)☐ None of:

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)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Restriction is required under 35 U.S.C. 121 and 372.

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1.

In accordance with 37 CFR 1.499, applicant is required, in reply to this action, to elect a single invention to which the claims must be restricted.

Group I, claim(s) 1-10, drawn to A secondary lithium ion battery and a method for improving the capacity, average operating voltage and specific energy of the same.

Group II, claim(s) 11-12, drawn to A protection circuit.

Group III, claim(s) 13-14, drawn to An electronic device.

Group IV, claim(s) 15-17, drawn to A charging device.

2. The inventions listed as Groups I to IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the ratio of positive electrode material to negative electrode material of a single cell is lacking among the groups.

3. In light of the complexity of the restriction requirement for this application, no telephone communication regarding the restriction has been made. See MPEP § 812.01.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species or invention to be examined even though the

requirement may be traversed (37 CFR 1.143) and (ii) identification of the claims encompassing the elected invention.

The election of an invention or species may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse.

4. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MUHAMMAD SIDDIQUEE whose telephone number is (571)270-3719. The examiner can normally be reached on Monday-Thursday, 7:30 am to 4:00 pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached on 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MSS

/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1795

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10491134	REN ET AL.
	Examiner	Art Unit
	MUHAMMAD SIDDIQUEE	1795

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/21/2008								
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PLUS Search Results for S/N 10491134, Searched Tue Jan 22 10:57:46 EST 2008

The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

5743921 99
5648187 99
6194874 99
5604057 99
5674644 99
6137265 99
5939864 99
6114835 99
4888258 99
5192629 99
5587133 99
5631539 99
5635138 99
5705291 99
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5196279 99
5209871 99
5215821 99
5225056 99
5332631 99
5376478 99
5413883 99
5514490 99
5518842 99
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5571634 99
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5645960 99
5667914 99
5684383 99
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5780991 99
5818203 99
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5825155 99
5866279 99
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5903131 99
5905362 99
5932373 99
5945804 99
5963019 99
5969502 99
5986430 99

OIPE JC25 JUL 21 2005 PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Xiaoping REN et al.

Title: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

Appl. No.: 10/491,134

Filing Date: 05/06/2004

Examiner: Melissa J. Austin

Art Unit: 1745

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT
UNDER 37 CFR §1.56

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

Sir:

Submitted herewith on Form PTO/SB/08 is a listing of documents known to Applicants in order to comply with Applicants' duty of disclosure pursuant to 37 CFR §1.56.

A copy of each non-U.S. patent document and each non-patent document is being submitted to comply with the provisions of 37 CFR §1.97 and §1.98.

The submission of any document herewith, which is not a statutory bar, is not intended as an admission that such document constitutes prior art against the claims of the present application or that such document is considered material to patentability as defined in 37 CFR §1.56(b). Applicants do not waive any rights to take any action which would be appropriate to antedate or otherwise remove as a competent reference any document which is determined to be a *prima facie* art reference against the claims of the present application.

TIMING OF THE DISCLOSURE

The listed documents are being submitted in compliance with 37 CFR §1.97(b), before the mailing date of the first Office Action on the merits.

RELEVANCE OF EACH DOCUMENT

A partial English language translation of the foreign-language document entitled *"Materials for New Energy"*, is submitted herewith. An English translation of the complete document is not readily available. However, the absence of such translation does not relieve the PTO from its duty to consider the submitted foreign language document (37 CFR §1.98 and MPEP §609).

Applicants respectfully request that each listed document be considered by the Examiner and be made of record in the present application and that an initialed copy of Form PTO/SB/08 be returned in accordance with MPEP §609.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 CFR §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

Respectfully submitted,

Date 21 July 2005

By S. A. Bent

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

MODIFIED PTO/SB/08 (08-00)
Approved for use through 10/31/2002. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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Substitute for form 1449B/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Date Submitted: July 21, 2005

(use as many sheets as necessary)

Sheet	1	of	1

Complete if Known	
Application Number	10/491,134
Filing Date	05/06/2004
First Named Inventor	Xiaoping REN
Group Art Unit	1745
Examiner Name	Melissa J. Austin
Attorney Docket Number	042787-0106

OIPE JC25 JUL 21 2005 PATENT & TRADEMARK OFFICE

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	U.S. Patent Document Number	U.S. Patent Document Kind Code[2] (*if known*)	Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Office[3]	Number[4]	Kind Code[5] (*if known*)	Name of Patentee or Applicant of Cited Documents	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]
	B1	K. MIZUSHIMA et al., "Li_xCo_2 (0<x<1): A NEW CATHODE MATERIAL FOR BATTERIES OF HIGH ENERGY DENSITY ", Mat. Res. Bull., Vol. 15, pp. 783-789 1980.	
	B2	G. PISTOIA et al., 'Synthesis of Mn spinels from different polymorphs of MnO_2" Journal of Power Sources, 56 (1995) 37-43.	
	B3	Lei Yongquan, "Materials for New Energy", 2000, pg. 136.	

Examiner Signature		Date Considered	

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

[1] Unique citation designation number. [2]See attached Kinds of U.S. Patent Documents. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

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PATENT & TRADEMARK OFFICE

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Atty. Dkt. No. 042787-0106

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Xiaoping REN et al.

Title: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

Appl. No.: 10/491,134

Filing Date: May 6, 2004

Examiner: Melissa J. Austin

Art Unit: 1745

INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR §1.56

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

Sir:

Submitted herewith on Form PTO/SB/08 is a listing of documents known to Applicants in order to comply with Applicants' duty of disclosure pursuant to 37 CFR §1.56. A copy of each listed document is being submitted to comply with the provisions of 37 CFR §1.97 and §1.98.

The submission of any document herewith, which is not a statutory bar, is not intended as an admission that such document constitutes prior art against the claims of the present application or that such document is considered material to patentability as defined in 37 CFR §1.56(b). Applicants do not waive any rights to take any action which would be appropriate to antedate or otherwise remove as a competent reference any document which is determined to be a *prima facie* art reference against the claims of the present application.

TIMING OF THE DISCLOSURE

The listed documents are being submitted in compliance with 37 CFR §1.97(b), before the mailing date of the first Office Action on the merits.

The PTO did not receive the following listed item(s) References marked as Asterisk cc. *11

RELEVANCE OF EACH DOCUMENT

Any document listed on the attached PTO/SB/08 was cited as being relevant during the prosecution of the corresponding International application. A copy of the International Search Report is attached setting forth the portion of each document considered relevant by the examiner. A copy of the documents cited in the Search Report are not being submitted herewith. An English-language counterpart of the foreign-language documents has not been provided. The absence of a translation or an English-language counterpart document does not relieve the PTO from its duty to consider any submitted document (37 CFR §1.98 and MPEP§609).

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Respectfully submitted,

Date 21 October 2004

By S. A. Bent

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Customer Number: 22428
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

OIPE JC25 OCT 21 2004 PATENT & TRADEMARK OFFICE

MODIFIED PTO/SB/08 (08-00)
Approved for use through 10/31/2002. 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.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

Date Submitted: October 21, 2004

(use as many sheets as necessary)

Sheet 1 of 1

Complete if Known	
Application Number	10/491,134
Filing Date	05/06/2004
First Named Inventor	Xiaoping REN
Group Art Unit	1745
Examiner Name	Melissa J. Austin
Attorney Docket Number	042787-0106

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	A3		CN 1185860 A			6/24/1998		
	A4		JP 2000-270491 A			9/29/2000		

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T[6]
	A5	International Search Report	

Examiner Signature		Date Considered	

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

[1] Unique citation designation number. [2]See attached Kinds of U.S. Patent Documents. [3]Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4]For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5]Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6]Applicant is to place a check mark here if English language Translation is attached.

Burden Hour Statement: This form is estimated to take 2.0 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, 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.

DT07 Rec'd PCT/PTO 30 SEP 2004

Atty. Dkt. No. 042787-0106

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Xiaoping REN et al.
Title:	*SECONDARY LITHIUM ION CELL OR ATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME*
Intl Appl. No.:	PCT/CN02/00696 filed 9/28/2002
Serial No.:	10/491,134
Filed:	May 6, 2004
Examiner:	Melissa J. Austin
Group Art Unit:	1745

SUPPLEMENTAL PRELIMINARY AMENDMENT

Mail Stop AMENDMENT
Commissioner for Patents
PO Box 1450
Alexandria, Virginia 22313-1450

Sir:

In response to the Notice of Non-Compliant Amendment dated September 24, 2004, Applicant respectfully resubmits the amendments filed previously on March 29, 2004 in the correct format.

Amendments to the Claims begin on page 2 of this document.

Remarks/Arguments begin on page 5 of this document.

Please amend the application as follows:

Complete Listing of the Claims:

Please amend the claims as follows:

1. (Currently Amended) A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that the charge cut-off voltage of the singe cell is greater than 4.2 V but less than 5.8 V~~, preferably within a ranger of 4.3 V to 5.2 V, and more preferably within a ranger from 4.3 V to 4.8 V~~; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, ~~preferably from 1:1.15 to 1:2.~~5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.

2. (Currently Amended) ~~A secondary lithium ion cell or battery, characterized in that the single secondary lithium ion cell has an charge cut-off voltage of greater than 4.2 V but less than 5.8 V, preferably within a range from 4.3 V to 5.2 V, and more preferably within a range of 4.3 V to 4.8 V; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by theoretic capacity~~ A method according to claim 1, characterized in that the charge cut-off voltage of the singe cell is within a range from 4.3 V to 5.2 V.

3. (Currently Amended) ~~A secondary lithium ion cell of battery according to claim 2, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V~~ A method according to claim 1, characterized in that the charge cut-off voltage of the singe cell is within a range from 4.3 V to 4.8 V.

4. (Currently Amended) ~~A protecting circuit for the secondary lithium ion cell or battery according to claims 2 or 3, characterized in that the single lithium ion cell of said protecting circuit has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V~~ A method according to claim 1, characterized in that the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.15 to 1:2.5.

5. (Currently Amended) ~~An electronic device using a secondary lithium ion cell or battery as energy source, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V~~ A secondary lithium ion cell or

battery, characterized in that the single secondary lithium ion cell has a charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, as calculated by the theoretic capacity with the charge cut-off voltage set at 4.2 V.

6. (Currently Amended) ~~A charging device for a secondary lithium ion cell or battery, characterized in that said charging device controls an charge cut-off voltage to the single lithium ion cell within the range of greater than 4.3 V but less than 5.8 V, preferably within the range from 4.3 V to 5.2 V, and more preferably within the range from 4.3 V to 4.8. V~~ A secondary lithium ion cell or battery according to claim 5, characterized in that the single secondary lithium ion cell has a charge cut-off voltage within a range from 4.3 V to 5.2 V.

7. (New) A secondary lithium ion cell or battery according to claim 5, characterized in that the single secondary lithium ion cell has a charge cut-off voltage within a range from 4.3 V to 4.8. V.

8. (New) A secondary lithium ion cell or battery according to claim 5, characterized in that the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.15 to 1:2.5.

9. (New) A secondary lithium ion cell or battery according to claim 5, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V.

10. (New) A secondary lithium ion cell or battery according to claim 9, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

11. (New) A protecting circuit for the secondary lithium ion cell or battery according to claim 5, characterized in that the single lithium ion cell of said protecting circuit has a first overcharge protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V.

12. (New) A protecting circuit according to claim 11, characterized in that the single lithium ion cell of said protecting circuit has a first overcharge protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

13. (New) An electronic device using a secondary lithium ion cell or battery as energy source, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has

a first overcharging protection voltage of greater than 4.35 V, and an overcharge protection release voltage of greater than 4.15 V.

14. (New) An electronic device according to claim 13, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

15. (New) A charging device for a secondary lithium ion cell or battery, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range of greater than 4.3 V but less than 5.8 V.

16. (New) A charging device according to claim 15, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range from 4.3 V to 5.2 V.

17. (New) A charging device according to claim 15, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range from 4.3 V to 4.8 V.

REMARKS

Applicant respectfully requests that the foregoing amendments be entered prior to examination of the present application, on the merits.

Applicant is submitting the attached amendment in proper U.S. claim format as required by the Notice to Non-Compliance issued September 24, 2004.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date 9/30/04

By _____
for Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

FOLEY & LARDNER, LLP
Customer Number: 22428
22428
22428
PATENT TRADEMARK OFFICE
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2003

Application or Docket Number: 10/491134

CLAIMS AS FILED - PART I

SMALL ENTITY TYPE ☑ OR OTHER THAN SMALL ENTITY

	(Column 1)	(Column 2)
TOTAL CLAIMS		
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	17 minus 20=	*
INDEPENDENT CLAIMS	4 minus 3 =	* 1
MULTIPLE DEPENDENT CLAIM PRESENT		☐

SMALL ENTITY RATE	FEE	OR	OTHER THAN SMALL ENTITY RATE	FEE
BASIC FEE	540	OR	BASIC FEE	
XS 9=		OR	XS18=	
X43=	43	OR	X86=	
+145=		OR	+290=	
TOTAL	583	OR	TOTAL	

* If the difference in column 1 is less than zero, enter "0" in column 2

9.30.04 CLAIMS AS AMENDED - PART II

SMALL ENTITY OR OTHER THAN SMALL ENTITY

AMENDMENT A	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 17	Minus	** 20	=
Independent	* 2	Minus	*** 3	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE	OR	RATE	ADDITIONAL FEE
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. 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 number found in the appropriate box in column 1.

FORM PTO-875 (Rev 10-03) — Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
10/249,134 10/000,000	OOOOO
Examiner	**Art Unit**
***	

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date								
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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.
10/491,134	05/06/2004	Xiaoping Ren	042787-0106	7003

22428 7590 09/24/2004

FOLEY AND LARDNER
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

EXAMINER	
AUSTIN, MELISSA J	

ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 09/24/2004

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

PTO-90C (Rev. 10/03)

UNITED STATES PATENT AND TRADEMARK OFFICE

10/491134/S.C

COMMISSIONER FOR PATENTS
UNITED STATES PATENT AND TRADEMARK OFFICE
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450
www.uspto.gov

Notice of Non-Compliant Amendment (37 CFR 1.121)

The amendment document filed on 3.29.04 is considered non-compliant because it has failed to meet the requirements of 37 CFR 1.121. In order for the amendment document to be compliant, correction of the following item(s) is required. **Only the corrected section of the non-compliant amendment document must be resubmitted (in its entirety), e.g., the entire "Amendments to the claims" section of applicant's amendment document must be re-submitted.** 37 CFR 1.121(h).

THE FOLLOWING CHECKED (X) ITEM(S) CAUSE THE AMENDMENT DOCUMENT TO BE NON-COMPLIANT:

☐ 1. Amendments to the specification:
- ☐ A. Amended paragraph(s) do not include markings.
- ☐ B. New paragraph(s) should not be underlined.
- ☐ C. Other_____

☐ 2. Abstract:
- ☐ A. Not presented on a separate sheet. 37 CFR 1.72.
- ☐ B. Other_____

☐ 3. Amendments to the drawings: _____

☐ 4. Amendments to the claims:
- ☐ A. A complete listing of all of the claims is not present.
- ☐ B. The listing of claims does not include the text of all pending claims (including withdrawn claims)
- ☑ C. Each claim has not been provided with the proper status identifier, and as such, the individual status of each claim cannot be identified. Note: the status of every claim must be indicated after its claim number by using one of the following 7 status identifiers: (Original), (Currently amended), (Canceled), (Withdrawn), (Previously presented), (New) and (Not entered).
- ☐ D. The claims of this amendment paper have not been presented in ascending numerical order.
- ☑ E. Other: Claims that has marking status identifier should read "currently amended"

For further explanation of the amendment format required by 37 CFR 1.121, see MPEP Sec. 714 and the USPTO website at http://www.uspto.gov/web/offices/pac/dapp/opla/preognotice/officeflyer.pdf .

If the non-compliant amendment is a **PRELIMINARY AMENDMENT,** applicant is given ONE MONTH from the mail date of this letter to supply the corrected section which complies with 37 CFR 1.121. Failure to comply with 37 CFR 1.121 will result in non-entry of the preliminary amendment and examination on the merits will commence without consideration of the proposed changes in the preliminary amendment(s). This notice is not an action under 35 U.S.C. 132, and **this ONE MONTH time limit is not extendable**.

If the non-compliant amendment is a reply to a **NON-FINAL OFFICE ACTION (including a submission for an RCE),** and since the amendment appears to be a *bona fide* attempt to be a reply (37 CFR 1.135(c)), applicant is given a TIME PERIOD of ONE MONTH from the mailing of this notice within which to re-submit the corrected section which complies with 37 CFR 1.121 in order to avoid abandonment. **EXTENSIONS OF THIS TIME PERIOD ARE AVAILABLE UNDER 37 CFR 1.136(a).**

If the amendment is a reply to a **FINAL REJECTION,** this form may be an attachment to an Advisory Action. **The period for response to a final rejection continues to run from the date set in the final rejection**, and is not affected by the non-compliant status of the amendment.

Rebecca Gitten — 571 272 0986

Legal Instruments Examiner (LIE) — Telephone No.

Rev. 6/04

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

U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
10/491,134	Xiaoping Ren	042787-0106

INTERNATIONAL APPLICATION NO.	
PCT/CN02/00696	
I.A. FILING DATE	PRIORITY DATE
09/28/2002	09/28/2001

22428
FOLEY AND LARDNER
SUITE 500
3000 K STREET NW
WASHINGTON, DC 20007

CONFIRMATION NO. 7003

371 ACCEPTANCE LETTER

OC000000013034450

Date Mailed: 06/25/2004

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office in its capacity as a Designated / Elected Office (37 CFR 1.495), has determined that the above identified international application has met the requirements of 35 U.S.C. 371, and is ACCEPTED for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above and the relevant dates are:

05/06/2004	05/06/2004
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

A Filing Receipt (PTO-103X) will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE " FILING DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1), (c)(2) and (c)(4) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN ABOVE.** *The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363).* Once the Filing Receipt has been received, send all correspondence to the Group Art Unit designated thereon.

The following items have been received:

- Indication of Small Entity Status
- Copy of the International Application filed on 03/29/2004
- Copy of the International Search Report filed on 03/29/2004
- Oath or Declaration filed on 05/06/2004
- Small Entity Statement filed on 03/29/2004
- Copy of references cited in ISR filed on 03/29/2004
- U.S. Basic National Fees filed on 03/29/2004

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

PATRICIA A BOOKER
Telephone: (703) 305-3738

PART 3 - OFFICE COPY

FORM PCT/DO/EO/903 (371 Acceptance Notice)

DT07 Rec'd PCT/PTO 06 MAY 2004

FORM PTO-1390 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE (REV 5-93)

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 042787-0106

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5): 10/491,134

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
CN02/00696	9/28/2002	9/28/2001

TITLE OF INVENTION
SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

APPLICANT(S) FOR DO/EO/US
Xiaoping REN et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☐ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☒ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☐ The US has been elected (Article 31).
5. ☐ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - ☐ is attached hereto (required only if not communicated by the International Bureau).
   - ☐ has been communicated by the International Bureau.
   - ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   - ☐ is attached hereto.
   - ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - ☐ are attached hereto (required only if not transmitted by the International Bureau).
   - ☐ have been communicated by the International Bureau.
   - ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - ☐ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A preliminary amendment.
14. ☐ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☐ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.2 and 37 CFR 1.821 – 1.825
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☐ Other items or information:

002.11195850.1 FORM PTO-1390 (Modified)

O. (If known, see 37 C.F.R. 1.50	NTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/491,134	CN02/00696	042787-0106

21. ☒ The following fees are submitted:					CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5):						
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO $1,080.00						
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO $920.00						
No international preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO $770.00						
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) $730.00						
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00						
ENTER APPROPRIATE BASIC FEE AMOUNT =					$ 0.00	
Surcharge of $130.00 for furnishing the oath or declaration later than 30 months from the earliest claimed priority date (37 CFR 1.492(e))					$ 0.00	
CLAIMS	NUMBER FILED		NUMBER EXTRA	RATE	$	
Total Claims	17	- 20 =	0	x $ 18.00	$ 0.00	
Independent Claims	4	- 3 =	1	x $ 86.00	$ 0.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+ $ 290.00	$	
TOTAL OF ABOVE CALCULATIONS =					$ 0.00	
☒ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.				+	$ 0.00	
SUBTOTAL =					$ 0.00	
Processing fee of 130.00 for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(f)).					$	
TOTAL NATIONAL FEE =					$ 0.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). 40.00 per property					$	
TOTAL FEES ENCLOSED =					$ 0.00	
					Amount to be refunded:	
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NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Foley & Lardner LLP

Customer Number: 22428

S. A. Bent

SIGNATURE

Stephen A. Bent

NAME

29,768

REGISTRATION NUMBER

IEC020210PUS.

Atty. Dkt. No. 042787-0106

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I HEREBY DECLARE:

THAT my residence, post office address, and citizenship are as stated below next to my name;

THAT I believe I am the original, first, and sole inventor (if only one inventor is named below) or an original, first, and joint inventor (if plural inventors are named below or in an attached Declaration) of the subject matter which is claimed and for which a patent is sought on the invention entitled

SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

(Attorney Docket No. 042787-0106)

the specification of which (check one)

___ is attached hereto.

_X_ was filed on 9/28/2002 as United States Application Number or PCT International Application Number PCT/CN02/00696 and was amended on _____ (if applicable).

THAT I do not know and do not believe that the same invention was ever known or used by others in the United States of America, or was patented or described in any printed publication in any country, before I (we) invented it;

THAT I do not know and do not believe that the same invention was patented or described in any printed publication in any country, or in public use or on sale in the United States of America, for more than one year prior to the filing date of this United States application;

THAT I do not know and do not believe that the same invention was first patented or made the subject of an inventor's certificate that issued in any country foreign to the United States of America before the filing date of this United States application if the foreign application was filed by me (us), or by my (our) legal representatives or assigns, more than twelve months (six months for design patents) prior to the filing date of this United States application;

THAT I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment specifically referred to above;

THAT I believe that the above-identified specification contains a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the invention, and sets forth the best mode contemplated by me of carrying out the invention; and

THAT I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I HEREBY CLAIM foreign priority benefits under Title 35, United States Code §119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number	Country	Foreign Filing Date	Priority Claimed?	Certified Copy Attached?
01141615.7	China P.R.	9/28/2001	YES	No

I HEREBY CLAIM the benefit under Title 35, United States Code § 119(e) of any United States provisional application(s) listed below.

U.S. Provisional Application Number	Filing Date

I HEREBY CLAIM the benefit under Title 35, United States Code, §120 of any United States application(s), or § 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application Number	PCT Parent Application Number	Parent Filing Date	Parent Patent Number

Atty. Dkt. No. 042787-0106

I HEREBY APPOINT the registered attorneys and agents at Customer Number 22428

Customer Number: 22428

to have full power to prosecute this application and any continuations, divisions, reissues, and reexaminations thereof, to receive the patent, and to transact all business in the United States Patent and Trademark Office connected therewith.

I request that all correspondence be directed to:

Stephen A. Bent
FOLEY & LARDNER LLP
Customer Number: 22428

Telephone: (202) 672-5404
Facsimile: (202) 672-5399

I UNDERSTAND AND AGREE THAT the foregoing attorneys and agents appointed by me to prosecute this application do not personally represent me or my legal interests, but instead represent the interests of the legal owner(s) of the invention described in this application.

I FURTHER DECLARE THAT all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

1

Name of first inventor	Xiaoping REN
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Date	2004.3.12

2

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Inventor's signature	Sun Jie
Date	2004.3.12

002.1174952.1

DT02 Rec'd PCT/PTO 29 MAR 2004

FORM PTO-1390 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE (REV 5-93)

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 042787-0106

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5): Unassigned 10/491134

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
CN02/00696	9/28/2002	9/28/2001

TITLE OF INVENTION: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

APPLICANT(S) FOR DO/EO/US: Xiaoping REN et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - ☐ is attached hereto (required only if not communicated by the International Bureau).
   - ☒ has been communicated by the International Bureau.
   - ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   - ☐ is attached hereto.
   - ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - ☐ are attached hereto (required only if not transmitted by the International Bureau).
   - ☐ have been communicated by the International Bureau.
   - ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A preliminary amendment.
14. ☒ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☐ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.2 and 37 CFR 1.821 – 1.825
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☐ Other items or information:

002.11174199.1 FORM PTO-1390 (Modified)

D111 Rec'd PCT/PTO 29 MAR 2004

O. (If known, see 37 C.F.R. 1.50	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
Unassigned 10/491134	CN02/00696	042787-0106

21. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....$1,080.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.....$920.00		
No international preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....$770.00		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4).....$730.00		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4).....$100.00		
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Surcharge of $130.00 for furnishing the oath or declaration later than 30 months from the earliest claimed priority date (37 CFR 1.492(e))	$ 130.00	

CLAIMS	NUMBER FILED		NUMBER EXTRA	RATE		$	
Total Claims	17	- 20 =	0	x $	18.00	$ 0.00	
Independent Claims	4	- 3 =	1	x $	86.00	$ 86.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+ $	290.00	$	
				TOTAL OF ABOVE CALCULATIONS =		$ 1296.00	
☒ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.				+		$ 648.00	
				SUBTOTAL =		$ 648.00	
Processing fee of 130.00 for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(f)).						$	
				TOTAL NATIONAL FEE =		$ 648.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). 40.00 per property						$	
				TOTAL FEES ENCLOSED =		$ 648.00	
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a. ☒ A check in the amount of $ 648. to cover the above fees is enclosed.

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NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Foley & Lardner LLP

Customer Number: 22428

Stephen Bent Reg No 37,789
SIGNATURE

Stephen A. Bent
NAME

29,768
REGISTRATION NUMBER

10/491134
D111 Rec'd PCT/PTO 29 MAR 2004

SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

TECHNICAL FIELD

The present invention relates to a new method for improving capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, and to a secondary lithium ion cell or battery prepared by using the method, a protecting circuit adapted for the secondary lithium ion cell or battery, a electronic device using the secondary lithium ion cell or battery, and a charging device for the secondary lithium ion cell or battery.

BACKGROUND ART

The industry of lithium ion cell develops quickly since SONY corporation of Japan invented and commercialized a secondary lithium ion cell. Up to 2000, the manufactures of lithium ion battery around the world compete allsidedly for improving the competitive power of their products mainly around the key issue, the capacity of lithium ion battery. At present, the improvement of capacity of commercialized secondary lithium ion battery generally depends on the increase of loading quantities of active substances (positive electrode materials and negative electrode materials). However, the limitation of the volume of lithium ion battery greatly restricts the increase of the battery capacity. For notably raising the capacity, the researches for the development of active substances (positive electrode materials and negative electrode materials) having higher specific energy are been conducting around the world, but so far, there is no notable breakthrough in this aspect for various technical difficulties.

In fact, the positive electrode materials and negative electrode materials used in the current secondary lithium ion battery have relatively higher theoretical capacity, and the problem merely lies in the lower actual utilization rate of said capacity. For example, lithium cobalt oxides as a positive electrode material of secondary lithium ion cell has a theoretical capacity of 248 mAh/g, while the actually used capacity of it is merely about 140 mAh/g, i.e., about half of said theoretic capacity is not utilized. This is mainly caused by the limitation of charge cut-off voltage commonly used in the art. At present, the charge cut-off voltage of single secondary lithium ion cell is limited to no more than 4.2 V, and this is well accepted as a technical requirement in the industry of manufacture of secondary lithium ion battery. Further, all lithium ion batteries in the markets around the world are manufactured under this technical requirement. For example, the charge cut-off voltage is limited to below 4.2 V and the overcharge release voltage of its protection circuit is controlled below 4.15 V during the formation of single lithium ion cell. The reasons that the charge cut-off voltage being limited to below 4.2 V lie in the following opinions in the prior research results and documents: although the capacity and average operating voltage are improved by increasing the charge cut-off voltage, the positive electrode materials and the negative electrode materials will undergo structure change, the electrolyte may

decompose, and the recycle property of the cell will be adversely affected when the charge cut-off voltage is greater than 4.2 V.

For instance, as to lithium cobalt oxides that is used as positive electrode material in the most commercial lithium ion batteries, the charge cut-off voltage is limited to below 4.2 V and the actual capacity is 120-140 mAh/g, i.e., about 50% of the theoretical capacity, although many documents indicate that the charge cut-off voltage can be over 4.2 V for a test cell using metallic lithium as counter electrode. In fact, according to MIZUSHIMAK et al., "A new cathode material for batteries of high energy density", Mater. Res. Bull., 1980, 15:783, the quantity of dedoped lithium ion increases with the increase of charge voltage, and the electrochemical capacity of lithium cobalt oxides increases accordingly. However, the study deems that the reversible charge-discharge voltage is about 4.3 V when metallic lithium is used as counter electrode, and when said voltage is higher than 4.3 V, the structure of lithium cobalt oxides changes and the lattice parameter C decreases from 4.4 nm to 4.0 nm, and thus the recycle life of cell is affected.

G. PISTOIA et al., J. Power Source, 56(1995), 37-43, deems that the structure the lithium cobalt oxides changes with the charge voltage, and the coexistence of monoclinic phase and hexagonal phase will appear when the charge voltage is over a certain value, which will spoil the recycle property of cell. The results of experiments showed that as to a test button cell having metallic lithium as negative electrode, the capacity of lithium cobalt oxides reaches 159 mAh/g when the charge cut-off voltage is 4.35 V, but it drops to 135 mAh/g after several cycles; and the capacity attenuates quickly when the charge cut-off voltage is 4.25 V. This document takes the opinion that lithium cobalt oxides maintains excellent recycle property and a capacity about 130 mAh/g only when the charge cut-off voltage is 4.15 V, and the corresponding voltages of monoclinic phase and hexagonal phase separately is 4.05 V and 4.17 V, i.e., both of them are below 4.2 V.

In addition, Lei Yongquan, "Materials for New Energy" (in Chinese), 2000, p136, discloses that the decomposition voltage of electrolyte solution using $LiPF_6$ as electrolyte and EC/DMC as mixture solvent is 4.2 V, and thus deems that the electrolyte solution will be decomposed and the recycle life will be affected when the charge cut-off voltage is above 4.2 V.

In 1990, Sony Corporation issued the lithium ion cell using coke as negative electrode, which has a charge cut-off voltage of not more than 4.20 V, and it is accepted as a common technical requirement of lithium ion cells thereafter.

The prior art deems:

1. The increase of charge cut-off voltage will change the structure of positive electrode material, which mainly exhibits at the following two aspects: one aspect is that the phase change, i.e., the coexistence of monoclinic phase

and hexagonal phase and the conversion between them may seriously affect the recycle life of lithium ion cell; and another aspect is that the change of lattice parameter may narrow the channel for passing lithium ions, squeeze the space occupied by lithium ions, jam the channel of lithium ions, and decrease the recycle property of lithium ion cell.

2. The elevated charge cut-off voltage may decompose the electrolyte solution, and the loss of electrolyte solution renders the transportation of lithium ion more difficult, and thus the recycle life of cell is seriously affected.

Therefore, it can be seen that the limitation of charge voltage restricts the actual utilization of active electrode materials. Under this condition, even if new positive electrode material and negative electrode material having higher specific energy are developed, the lithium ion cell cannot exhibit the best performance. Hence, it is urgently needed to provide a method that can improve the efficacy of active substances of lithium ion cell, consequently increase the capacity and average operating voltage, and maintain the better cell performance simultaneously.

SUMMARY OF INVENTION

As to the common opinion in the art that increasing the charge cut-off voltage above 4.2 V may greatly shorten the recycle life, the inventor of the present invention conducted a large number of experiments and studies to elevate the charge cut-off voltage and the capacity of cell. Contrary to this opinion, the inventor unexpectedly found that the efficacy of electrode active materials is greatly increased by increasing the charge cut-off voltage and properly adjusting the ratio of positive electrode material to negative electrode material of single lithium ion cell. Consequently, the specific energy, capacity and average operating voltage of secondary lithium ion cell or battery are improved, while the performance of cell is substantially not changed. The present invention is fulfilled based on the aforesaid discovery.

It is one object of the present invention to provide a new method for improving capacity, average operating voltage and energy density of a secondary lithium ion cell or battery, wherein the charge cut-off voltage of the singe cell is greater than 4.2 V, and less than 5.8 V, and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.

Another object of the present invention is to provide a secondary lithium ion cell or battery, wherein the single secondary lithium ion cell has an charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.

Yet another object of the present invention is to provide a protecting circuit adapted for the secondary lithium ion cell or battery, said protecting circuit having a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V.

Yet another object of the present invention is to provide an electronic device using the secondary lithium ion cell or battery as power supply, said electronic device comprising a protecting circuit having a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V.

Yet another object of the present invention is to provide a charging device for the secondary lithium ion cell or battery, said charging device controlling an charge cut-off voltage for the single lithium ion cell within the range of greater than 4.3 V but less than 5.8 V, preferably within the range from 4.3 V to 5.2 V, and more preferably from 4.3 V to 4.8 V.

EMBODIMENTS FOR CARRYING OUT THE PRESENT INVENTION

Being contrary to the common opinion in the art that the charge cut-off voltage shall be controlled below 4.2 V, the present inventor unexpectedly found that the capacity, specific energy and average operating voltage of the secondary lithium ion cell or battery were notably improved with little cost and with the other properties substantially unchanged, when investigating the effect of the elevated charge cut-off voltage on the cell performances with a large number of experiments of gradually elevating the charge cut-off voltage and appropriately adjusting the ratio of the positive electrode to the negative electrode of the single lithium ion cell. In the present invention, "lithium ion cell or battery" means that the present invention can be applied to either a single lithium ion cell, or a single lithium ion cell comprising a protecting circuit, or a battery comprising a number of single lithium ion cells, or a battery comprising a number of single lithium ion cell and protecting circuits. For briefness, sometimes it may also be termed as "lithium ion cell". In addition, "theoretical capacities of positive electrode and negative electrode" means the capacities of the positive electrode and the negative electrode calculated with an charge cut-off voltage set at 4.2 V.

The present inventor studied the relation between the charge cut-off voltage and the cell properties of secondary lithium ion cell by gradually elevating the charge cut-off voltage. For example, in the formation test for the commercial secondary single lithium ion cells and the self made single secondary lithium ion cells, the inventor elevated the charge cut-off voltage from 4.2 V to 4.30 V, 4.35 V, 4.40 V, 4.45 V and 4.6 V, and the results showed that when the charge cut-off voltage is, 4.3 V, 4.35 V and 4.40 V, the specific energy of cell increases by 6-20% than that under the charge cut-off voltage of 4.2 V, and the cells still maintain excellent recycle property, e.g., the capacity maintains more than 95% after 50 cycles, and more than 80% after 300 cycles,. However, when the charge cut-off voltage is 4.45 V or high, the specific energy increases by about 30%, but the cell exhibits

inferior recycle property, e.g., the capacity maintains merely 83.9% after 6 cycles.

For investigating the reasons of poor recycle property when the charge cut-off voltage is 4.45 V or high, the inventor adjusted the ratio of positive electrode material to negative electrode material, i.e., said ratio was adjusted within the range from 1:1.3 to 1:2.5 calculated according to the theoretical capacity under the charge cut-off voltage of 4.2 V, and then the single lithium ion cell having the adjusted ratios were tested by charging at an charge cut-off voltage of 4.45 V, 4.6 V, 4.8 V, 5.0 V, 5.2 V, 5.4 V, 5.6 V and 5.8 V, preferably said charging tests were conducted during the formation and test of the cells. Experimental results show that the specific energy was greatly increased under the charge cut-off voltage of 4.45 V or higher, and the corresponding recycle property was essentially not affected, when appropriate ratios of positive electrode material to negative electrode material were adopted.

In the present method, the elevating of the charge cut-off voltage is advantageously carried out during the formation and examination of the cell. The use of charge cut-off voltage of 4.20 V or high could increase the specific energy of cell, the capacity of positive electrode active material and the average operating voltage, and activate the cell so that the cell reaches its optimal working state with simultaneously achieving the effect of the formation, substantial improvement of the specific energy of commercial lithium ion cells, and imparting the competitiveness of lithium ion cells without altering the original process.

The mechanism of the above experimental results needs more researches. Without limited by any theory, the presumed reasons are as follows.

1. After the elevation of charge cut-off voltage, the amount of lithium ion dedoped from the positive electrode greatly increases, which renders an unmatched state to the original negative electrode material, and deposition of excessive lithium ions on the surface of negative electrode as metallic lithium, which jam part of the channel for passing lithium ions and result in the reduction of capacity and the deterioration of recycle property. The increase of the amount of negative electrode material meets the requirement of doping the relatively excessive lithium ions, and avoids the deposition of lithium ions on the surface of negative electrode as metallic lithium, and thus the maintaining properties (self-discharge properties) and recycle property are not affected. The suitable ratio of positive electrode material to negative electrode material will avoid the deposition of metallic lithium on the surface of negative electrode and the obstruction of channel for passing lithium ions, and consequently avoid the attenuation of capacity of cell. In particular, when the charge cut-off voltage of lithium ion cell is greater than 4.45 V, the negative electrode material of the ordinary commercial lithium ion cell is still more deficient, and the excessive lithium ions will deposit on the surface of negative electrode and form metallic lithium, which jams the channel for

passing lithium ions and attenuates the capacity of cell. The great increase of content of negative electrode could reduce the attenuation of capacity of lithium ion cell caused by the increase of recycle times. According to this viewpoint, the inventor performed a lot of experiments, and the results prove the aforesaid assumption (see the Examples).

2. Within a certain range of charge cut-off voltage, the decomposition of little electrolyte solution brings about negligible effect on the recycle property of cell. The electrolyte having a high decomposition potential or an additive increasing the decomposition potential of electrolyte solution may bring about better performance. The decomposition of electrolyte solution mainly occurs on the positive electrode. Although prior documents disclosed that the decomposition voltage of the electrolyte solution comprising $LiPF_6$ as electrolyte and the mixture of EC/DMC as solvent on the surface of aluminum foil is 4.2 V, according to the results of experiments, this factor essentially does not affect the recycle life of the currently commercialized lithium ion cell. Namely, even though the electrolyte solution decomposes under a voltage higher than 4.2 V, the electric energy is mainly converted into chemical energy and the electric energy involved in the decomposition of electrolyte is very little, thus, this decomposition of electrolyte can hardly affect the recycle life of the lithium ion cell. As to the voltages above the decomposition voltage, such as above 5.0 V, the substance A can be added into the electrolyte solution, or the electrolyte solution B having a higher decomposition voltage can be used. The decomposition potentials of the components of electrolyte solution commonly used in the art are depicted in Table 1. It can be seen that the lowest decomposition voltage of solvent is above 4.5 V.

Table 1. Decomposition potentials of various mixture electrolyte solutions

Solute	$LiClO_4$	$LiAsF_6$	$LiPF_6$
Mixture solvent	Decomposition potentials (V)	Decomposition potentials (V)	Decomposition potentials (V)
PC:DME	4.51	4.72	
PC:DEC	4.5	4.5	
PC:EC		4.5	
PC:EC:DME	4.5	4.62	
PC:DEC:2MLF		4.52	
EC:DEC		4.9	4.8
EC:DMC			4.9
B			5.9

3. As to the reason that the lithium ion cell does not appear attenuation of capacity caused by the change of structure as mentioned in the prior documents when the charge cut-off voltage is above 4.2 V, it may be due to that: after the ithium ions first intercalaton into anode, there is about 10% lithium ions which form a SEI film, so that the actual space of the lithium ions is more than the space that should be occupied by the lithium ions, i.e., the

space available to the lithium ions exceeds about 10% of the space needed by the activated lithium ions, thus, although the elevation of the charge voltage changes the structure of positive electrode material, i.e., reduces the lattice parameter, the recycle life is not affected because the space occupied by the actually deintercalation and intercalation lithium ions is less than the space actually possessed by the positive electrode material, and thus the change of structure in a certain extent will not obstruct the dedoping and doping of lithium ions and will not affect the recycle life of cell. Using positive material more stable in structure with respect to the change of charge voltage exhibit better performance. Although the positive electrode generates inert substance poor in conductivity when overcharged, according to the results of experiments, it occurs only when the lithium ions completely dedoped. For example, as to lithium cobalt oxides, lithium nickel oxides, and doped lithium cobalt oxides and lithium nickel oxides, when they are charged with 3C5A current, the experimental data show that only when the voltage is about 6.20 V the lithium ions completely dedoped, with releasing a lot of oxygen, and forming an insulator. As to lithium manganese oxides and doped lithium manganese oxides, the lithium ions completely dedoped under the same charge current when the cell potential is about 6.50 V. Generally, the specific energy of positive electrode active substance actually used in the present commercialized lithium ion cell is far less than the theoretical capacity thereof, and even if the charge cut-off voltage is elevated up to 5.8 V, the theoretical capacity cannot be achieved under the proviso that suitable formulation is used, thus, the cell is not overcharged. Therefore, the present method still enjoys satisfactory safety.

4. Besides the aforementioned factors, the self-discharge of cell, the selection of current collector, and the formation of passive film all affect the recycle life of lithium ion cell, while these factors mainly depend on the preparation of lithium ion cell. It is believable that if the optimal processes are used, the capacity, average operating voltage and specific energy can be greatly improved, while the recycle life and other properties of the cell are not affected.

Hence, the present invention is to provide a novel method for effectively improving the specific energy and average operating voltage of secondary lithium ion cell or battery. Contrary to the prior art, the present method elevates the charge cut-off voltage to greater than 4.2 V but less than 5.8 V, and control the ratio of positive electrode material to negative electrode material of single lithium ion cell at 1:1.0 to 1:2.5 calculated by theoretical specific energy, so as to increase the efficacy of electrode active materials, to improve the capacity, energy density and output voltage of cell, and to maintain the performance of cell. For achieving the better effect, the charge cut-off voltage used in the present invention is preferably 4.3-5.2 V, and more preferably 4.2-4.8 V. In addition, the ratio of positive electrode material to negative electrode material of cell is 1:1.0 to 1:2.5 calculated by the

theoretical capacity under the charge cut-off voltage of 4.2 V. The experiments showed that when the process parameters go beyond the aforesaid ranges, the properties of cell are deteriorated and unsuitable for use. When the ratio of positive electrode material to negative electrode material is less than 1.0 calculated by theoretical capacity, the recycle life of cell is excessively reduced, while when said ratio is greater than 2.5, the volume efficiency of cell is notably reduced. Further, when the charge cut-off voltage is greater than 5.8 V, the cell has inferior properties and is unsuitable for use.

It can be seen that the capacity, specific energy and average operating voltage of secondary lithium ion cell can be greatly improved by elevating the charge cut-off voltage and by appropriately adjusting the ratio of positive electrode material to negative electrode material calculated by the theoretical capacity, while the recycle property of cell is not affected, which renders the lithium ion cell possess more commercial value and broader application range. Hence, it can also be seen that the present method further optimizes the utilization of positive electrode material, and thus is an economical method. The inventors believe that the method can still be used to positive and negative electrode materials having higher specific energy developed in future, and achieves the optimal effect.

In addition, it is worthy to be noted that the used in the present method is not such that the cell works in extreme conditions. After repetitive experiments, the inventor never found that the present method increased the probability of damage of cell. Hence, the present method is also a safe method.

Further, the present invention further provides a novel secondary cell or battery having improved specific energy and average operating voltage. Contrary to the prior art, the charge cut-off voltage of the single cell of said secondary cell or battery is greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material calculated by the theoretical capacity under the charge cut-off voltage of 4.2 V is 1:1.0 to 1:2.5. As compared to the prior secondary lithium ion cell or battery cell, the capacity, energy density and output voltage of the present secondary lithium ion cell or battery are greatly improved, while its recycle life is equivalent to that of the prior art cell. For achieving better effect, the aforesaid charge cut-off voltage used in the present invention is preferably in the range from 4.3 V to 5.2 V, more preferably in the range from 4.3 V to 4.8 V. In addition, the ratio of positive electrode material to negative electrode material of said singe lithium ion cell, which is calculated by the theoretical capacity under the charge cut-off voltage of 4.2 V, is 1:1.5 to 1:2.5. Experiments showed that when the process parameters go beyond the aforesaid ranges, the properties of cell are deteriorated and unsuitable for use. When the ratio of positive electrode material to negative electrode material is less than 1.0 calculated by theoretical capacity, the recycle life of cell is excessively reduced, while when said ratio is greater than 2.5, the volume efficiency of cell is notably reduced. Further, when the charge cut-off voltage is greater than 5.8 V, the cell has inferior properties and is unsuitable for use.

Moreover, it is important that the present method not only can be used to the secondary lithium ion cell or battery of the present invention, but also can be used to the secondary lithium ion cell or battery prepared according to the method of the prior art, such as the present commercialized secondary lithium ion cell or battery.

Without limitation, the following contents more concretely introduce the secondary lithium ion cell used in the present method. Generally, a secondary lithium ion cell comprises a positive electrode, a negative electrode, a non-aqueous electrolyte, and a separator the positive electrode and the negative electrode. The non-aqueous electrolyte can be obtained by dissolving lithium-containing metal salt, such as $LiPF_6$, as electrolyte into a non-aqueous solvent, such as ethylene carbonate or dimethyl carbonate. The separator can be insoluble in said non-aqueous solvent, and is a porous membrane made of polyethylene or polypropylene resin. The ratio of positive electrode material to negative electrode material is calculated by theoretical capacity under the charge cut-off voltage of 4.2 V.

Positive electrode

The positive electrode is prepared e.g., by dispersing positive electrode active material, conducting agent and binder in a suitable solvent to form a suspension, coating said suspension on a current collector, such as aluminum foil, then drying and pressing the coated current collector by rollers.

The positive electrode active substance used in the present invention is lithium-containing compound. Although the examples use lithium cobalt oxides (lithium cobalt composite oxides), lithium manganese oxides and lithium nickel oxides as positive electrode material, it is understood that the practice of the present invention is not limited to the specific properties of said lithium-containing composite oxides, rather a wide range of positive electrode active substance can be used in the present invention. The common feature of these oxides is that their specific energy increases with the increase of voltage, and the experiments (see the examples) prove that the capacity of cell is greatly elevated when the charge cut-off voltage is above 4.20 V, while the other properties of cell are not affected. The present invention can also be used to lithium ion cells having doped lithium-containing compound as positive electrode active material, such as various positive electrode active materials containing various oxides and sulfides, such as lithium cobalt composite oxides, lithium manganese composite oxides, lithium nickel composite oxides, lithium nickel cobalt composite oxides, lithium manganese cobalt composite oxides, and vanadium oxides. Among these positive electrode materials, lithium cobalt composite oxides (such as $LiCoO_2$), lithium manganese composite oxides (such as $LiMn_2O_4$), lithium nickel composite oxides (such as $LiNiO_2$), lithium nickel cobalt composite oxides (such as $LiNi_{1-x}Co_xO_2$), and lithium manganese cobalt composite oxides (such as $LiMn_xCo_{1-x}O_2$), which have higher cell voltage, are preferably used. In addition,

the present invention can use conventional conducting agent and binder, and the mixture ratio for each components in the positive electrode active material can be those well known in the art.

Separator

The separator used in the present invention is a separator well known in the art. For example, it can be a non-woven fabric made of synthetic resin, polyethylene porous membrane or polypropylene porous membrane, and a material formed by like materials.

Negative electrode

The negative electrode is prepared e.g., by dispersing negative electrode active material, conducting agent and binder in a suitable solvent to form a suspension, coating said suspension on a current collector, such as copper foil, nickel foil or stainless steel foil, then drying and pressing the coated current collector by rollers.

The negative electrode active material used in the present invention is a carbonaceous or non-carbonaceous substance capable of doping and dedoping lithium ion, including, such as, lithium alloy (such as $Li_4Ti_5O_{12}$), metal oxide (such as amorphous tin oxide, WO_2 and MoO_2), TiS_2 and carbonaceous substance capable of absorbing and desorbing lithium ions, and especially, the carbonaceous substance is the desired negative electrode active material.

The carbonaceous substance used in the present invention includes: graphite, non-oriented graphite, coke, carbon fiber, spherical carbon, carbon sintered from resin, carbon grown in gas phase, and carbon nanometer tube. Since the negative electrode comprising the aforesaid specific carbon fiber or spherical carbon exhibits high charge efficiency, mesophase asphalt based carbon fiber or mesophase asphalt based spherical carbon is preferably used as the carbonaceous substance. The mesophase asphalt based carbon fiber or mesophase asphalt based spherical carbon can be obtained according to the conventional method.

Without any specific restriction, non-aqueous electrolytes and shells of the type well known in the art can be used in the present invention. For example, use can be made of non-aqueous electrolyte is a liquid non-aqueous electrolyte prepared by dissolving electrolyte in a non-aqueous solvent, a gel non-aqueous electrolyte prepared by mixing polymer, non-aqueous solvent and solute, or a solid polymer non-aqueous electrolyte, etc.

The cell structure can be a helical structure formed by wrapping anode and cathode with a separator inbetween, or a laminate structure formed by stacking anode and cathode with a separator inbetween, but the structure of cell is not

limited to a certain shape, and it can be cylinder shape, prism shape, coin shape, button shape and so on.

Except voltage, all process parameters for charge and discharge are commonly used in the art.

Since the voltage used in the present invention is higher than the voltage currently used in the art, the necessary modification is made to the protecting circuit or relevant devices and equipments comprising said circuit which are used in the present method and for the present secondary lithium ion cell. The type and structure of the protecting circuit for said secondary lithium ion cell or battery shall not be specifically restricted, i.e., the well known structure can be used, provided that the first overcharging protection voltage is greater than 4.35 V, and the overcharge release voltage is greater than 4.15 V, preferably the first overcharging protection voltage is greater than 4.45 V, and the overcharge release voltage is greater than 4.25 V.

In addition, the electronic device of the present invention using a secondary lithium ion cell or battery as energy source shall not be specifically limited. The device can be a common structure, provided that said electronic device containing a single lithium ion cell having a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and the overcharge release voltage of greater than 4.25 V. The electronic device of the present invention includes: notebook type computer, PDA, electromotive bicycle, and electromotive automobile etc.

Similarly, the charging device for the secondary lithium ion cell or battery of the present invention can be a charging device having any type and structure with the proviso that said charging device controls the charge cut-off voltage of the single lithium ion cell within a range from 4.3 V to 5.8 V, preferably from 4.3 V to 5.2 V, more preferably from 4.3 V to 4.8 V.

EXAMPLES

The present invention is described in detail hereinafter according to the results of specific experiments.

Preparation of single lithium ion cell

In one of examples of the present invention, the process for preparing the single lithium ion cell is described as follows.

Said single lithium ion cell uses copper foil as current collector of negative electrode, aluminum foil as current collector of positive electrode, lithium cobalt oxides as positive electrode active substance, and MCMB as negative electrode

active substance. The type of cell is prismatic 653466. The lithium cobalt oxides is mixed with 7% PVDF as binder and 5% conductive carbon black, and then is added into NMP solvent in a ratio of 1:1. The negative electrode material is directly mixed with 10% PVDF as binder in a ratio of 1:1 to form a slurry. The positive electrode slurry is coated on the positive electrode current collector, and the negative electrode slurry is coated on the negative electrode current collector, and then they are dried and pressed, and treated by coating. The coating slurry for the positive electrode is prepared by dissolving a mixture of carbonaceous material and PVDF in an organic solvent, which is coated on the dried positive electrode. The coated positive electrode is pressed and baked again.

The dried positive electrode and negative electrode are connected to a lead, and a separator made of PP is inserted between them. After being wrapped by a winder to form an assembly, and this assembly is mounted into a cell shell made of aluminum or steel material. The shell and the cover are soldered together by laser soldering. An electrolyte solution is injected into the cell under relative humidity less than 1.5%, wherein said electrolyte solution contains a mixture solvent of EC:DEC:DMC = 1:1:1, and an electrolyte of 1M $LiPF_6$. The cell is immediately sealed after the injection.

Example 1

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

Example 2

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

Example 3

Several lithium ion cells of quadrate type 653466 are prepared according to the above method, and they each have a ratio of positive electrode material to negative electrode material of 1:1.0, 1:1.05, 1:1.1, 1:1.15, 1:1.2, 1:1.25 and 1:1.3. After formation and test using an charge cut-off voltage of 4.35 V, these cells

have an arithmetic mean capacity of 1253 mAh, a weight specific energy of 119 Wh/kg, an average operating voltage of 3.8 V, and maintain 84.79% of capacity after 400 recycles.

Example 4

Several lithium ion cells of quadrate type 653466 are prepared according to the above method, and they each have a ratio of positive electrode material to negative electrode material of 1:1.0, 1:1.05, 1:1.1, 1:1.15, 1:1.2, 1:1.25 and 1:1.3. After formation and test using an charge cut-off voltage of 4.40 V, these cells have an arithmetic mean capacity of 1302 mAh, a weight specific energy of 123 Wh/kg, an average operating voltage of 3.80 V, and maintain 83.93% of capacity after 400 recycles.

Example 5

Lithium ion cells of quadrate type 653466 are prepared according to the above method, and it has a ratio of positive electrode material to negative electrode material of 1:1.45. After formation and test using an charge cut-off voltage of 4.45 V, said cell has a capacity of 1365 mAh, a weight specific energy of 129 Wh/kg, an average operating voltage of 3.85 V, and maintain 84.56% of capacity after 400 recycles.

Example 6

Lithium ion cells of quadrate type 653466 are prepared according to the above method, and it has a ratio of positive electrode material to negative electrode material of 1:1.60. After formation and test using an charge cut-off voltage of 4.60 V, said cell has a capacity of 1692 mAh, a weight specific energy of 165 Wh/kg, an average operating voltage of 3.9 V, and maintain 85.13% of capacity after 400 recycles.

Example 7

Lithium ion cells of quadrate type 653466 are prepared according to the above method, and it has the ratio of positive electrode material to negative electrode material of 1:1.7. After formation and test using an charge cut-off voltage of 4.80 V, said cell has a capacity of 1824 mAh, a weight specific energy of 178 Wh/kg, an average operating voltage of 3.9 V, and maintain 83.92% of capacity after 400 recycles.

Example 8

Lithium ion cells of quadrate type 653466 are prepared according to the above method, and it has the ratio of positive electrode material to negative electrode material of 1:1.9, wherein the substance A having high decomposition potential is

added, or the electrolyte solution B having high decomposition potential is used. After formation and test using an charge cut-off voltage of 5.00 V, said cell has a capacity of 1894 mAh, a weight specific energy of 186 Wh/kg, an average operating voltage of 3.93 V, and maintain 81.23% of capacity after 400 recycles.

Example 9

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.2. After formation and test using an charge cut-off voltage of 5.20 V, said cell has a capacity of 1962 mAh, a weight specific energy of 194 Wh/kg, an average operating voltage of 3.96 V, and maintain 81.19% of capacity after 400 recycles.

Example 10

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.3. After formation and test using an charge cut-off voltage of 5.40 V, said cell has a capacity of 1968 mAh, a weight specific energy of 195 Wh/kg, an average operating voltage of 3.96 V, and maintain 81.19% of capacity after 400 recycles.

Example 11

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.4. After formation and test using an charge cut-off voltage of 5.60 V, said cell has a capacity of 1970 mAh, a weight specific energy of 195 Wh/kg, an average operating voltage of 3.96 V, and maintain 79.97% of capacity after 400 recycles.

Example 12

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.5. After formation and test using an charge cut-off voltage of 5.80 V, said cell has a capacity of 1972 mAh, a weight specific energy of 195 Wh/kg, an average operating voltage of 3.96 V, and maintain 78.82% of capacity after 400 recycles.

Example 13

Lithium ion cells of quadrate type 653466 are prepared according to the above method, wherein 15% of another lithium-containing compound C is added into the positive electrode slurry, and the ratio of positive electrode material to negative electrode material is 1:2.6. After formation and test using an charge cut-off voltage of 5.90 V, said cell has a capacity of 1565 mAh, and maintain 12.31% of capacity after 15 cycles.

It can be seen from the above examples that when the charge voltage is elevated above 4.2 V, the capacity, operating voltage and weight specific energy increase with the elevation of the charge voltage; and when the charge voltage is elevated above 4.45 V, the capacity, operating voltage and weight specific energy continuously further increase with the elevation of the charge voltage and of the ratio of positive electrode material to negative electrode material; but when the charge voltage is greater than 5.8 V, the properties of cell decrease.

Examples 14-18

Using lithium manganese oxide as positive electrode active material, Lithium ion cells are prepared according to the aforesaid method, wherein the positive electrode slurry consists of 4 g lithium manganese oxide, 0.6 g carbon black, 0.32 g PVDF, and 4.92 g NMP, and the negative electrode slurry consists of 2.6 g MCMB, 0.26 g PVDF, and 3.0 g NMP. The cell is a quadrate type 653466 lithium ion cell. The data of experiments are depicted in Table 2.

Table 2

Example	Charge cut-off voltage (V)	Processing change	Recycle property	Capacity (mAh)
14	4.20	--	Maintaining 84.23% after 400 recycles	375
15	4.30	--	Maintaining 85.12% after 400 recycles	405
16	4.60	The ratio of positive electrode material to negative electrode material is 1:1.6.	Maintaining 83.45% after 400 recycles	575
17	5.80	The ratio of positive electrode material to negative electrode material is 1:2.5, and substance A is added into the electrolyte solution.	Maintaining 82.83% after 400 recycles	567
18	5.90	The ratio of positive electrode material to negative electrode material is 1:2.7, and substance A is added into the electrolyte solution.	Maintaining 54.23% after 30 cycles	312

Examples 14-18 show that when using lithium manganese oxide as positive electrode active material, the cells obtain the results similar to that of examples

1-13. Namely, when the charge voltage is elevated above 4.2 V, the capacity, operating voltage and weight specific energy increase with the elevation of the charge voltage; and when the charge voltage is elevated above 4.45 V, the capacity, operating voltage and weight specific energy continuously increase with the elevation of the charge voltage and of the ratio of positive electrode material to negative electrode material; but when the charge voltage is greater than 5.8 V, the properties of cell decrease.

Examples 19-23

Using lithium nickel oxide as positive electrode active material, Secondary lithium ion cells are prepared according to the aforesaid method for preparing the lithium ion cells using lithium cobalt oxide as positive electrode active material, wherein the positive electrode slurry consists of 4 g lithium nickel oxide, 0.2 g carbon black, 0.2 g PVDF, and 4.80 g NMP, and the negative electrode slurry consists of 3.5 g MCMB, 0.35 g PVDF, and 4.0 g NMP. The cell is a quadrate type 063048 lithium ion cell. The data of experiments are depicted in Table 3.

Table 3

Example	Charge cut-off voltage (V)	Processing change	Recycle property	Capacity (mAh)
19	4.20	--	Maintaining 81.23% after 400 recycles	610
20	4.30	--	Maintaining 80.72% after 400 recycles	675
21	4.60	The ratio of positive electrode material to negative electrode material is 1:1.6.	Maintaining 78.32% after 400 recycles	912
22	5.80	The ratio of positive electrode material to negative electrode material is 1:2.5, and substance A is added into the electrolyte solution.	Maintaining 75.83% after 400 recycles	879
23	5.90	The ratio of positive electrode material to negative electrode material is 1:2.7, and substance A is added into the electrolyte solution.	Maintaining 47.53% after 50 cycles	796

Examples 19-23 show that when using lithium nickel oxide as positive electrode

active material, the cells obtain the results similar to those of examples 1-16. Namely, when the charge voltage is elevated above 4.2 V, the capacity, operating voltage and weight specific energy increase with the elevation of the charge voltage; and when the charge voltage is elevated above 4.45 V, the capacity, operating voltage and weight specific energy continuously increase with the elevation of the charge voltage and of the ratio of positive electrode material to negative electrode material; but when the charge voltage is greater than 5.8 V, the properties of cell decrease.

Examples 24-28

Using cobalt-doping lithium nickel oxide as positive electrode active material, a secondary lithium ion cell is prepared according to the aforesaid method for preparing the secondary lithium ion cells using lithium cobalt oxide as positive electrode active material, wherein the positive electrode slurry consists of 4 g lithium nickel oxide, 0.2 g carbon black, 0.2 g PVDF, and 4.80 g NMP, and the negative electrode slurry consists of 3.5 g MCMB, 0.35 g PVDF, and 4.0 g NMP. The cell is a quadrate type 063048 lithium ion cell. The data of experiments are depicted in Table 4.

Table 4

Example	Charge cut-off voltage (V)	Processing change	Recycle property	Capacity (mAh)
24	4.20	—	Maintaining 81.23% after 400 recycles	623
25	4.30	—	Maintaining 80.72% after 400 recycles	682
26	4.60	The ratio of positive electrode material to negative electrode material is 1:1.6.	Maintaining 78.32% after 400 recycles	934
27	5.80	The ratio of positive electrode material to negative electrode material is 1:2.5, and substance A is added into the electrolyte solution.	Maintaining 75.83% after 400 recycles	919
28	5.90	The ratio of positive electrode material to negative electrode material is 1:2.7, and substance A is added into the electrolyte solution.	Maintaining 39.53% after 50 cycles	697

Examples 24-28 show that when using cobalt-doping lithium nickel oxide as positive electrode active material, the cells obtain the results similar to those of examples 1-21. Namely, when the charge voltage is elevated above 4.2 V, the capacity, operating voltage and weight specific energy increase with the elevation of the charge voltage; and when the charge voltage is elevated above 4.45 V, the capacity, operating voltage and weight specific energy continuously increase with the elevation of the charge voltage and of the ratio of positive electrode material to negative electrode material; but when the charge voltage is greater than 5.8 V, the properties of cell decrease. In the meantime, these results indicate that the present method is not limited to some specific lithium-containing composite oxides as positive electrode material, but can be widely used in various secondary lithium ion cells.

The present method can be used in the production of lithium ion cell and for improvement of relevant products in the following aspects.

1. After adjustment of ratio of positive electrode material to negative electrode material so that the single lithium ion cell obtains the optimal capacity calculated by theoretical specific energy, a secondary lithium ion cell having high capacity and excellent recycle property can be obtained by controlling the charge cut-off voltage within a range from 4.2 V to 5.8 V during the formation and test of the cell. The merits of this method lie in that the specific energy and average operating voltage are greatly improved without substantially increasing the cost and simultaneously with the effects that the original formation process should achieve. Thus, as to the manufacturer of lithium ion cell, the profit margin and the competitiveness of enterprise are improved; and as to the products using lithium ion cells, their performances are improved with the increase of capacity and average operating voltage of the lithium ion cells.

2. The protecting circuit of single secondary lithium ion cell based on the present invention possesses an overcharge release voltage of greater than 4.15 V, and an overcharge first protection voltage of greater than 4.35 V.

3. The single lithium ion cell prepared according to the present invention can combine with the aforesaid protecting circuit having the technical features of the present invention and form a secondary lithium ion cell or battery.

4. The protecting circuit having the technical features of the present invention can be used in a mobile electronic device and product having a secondary lithium ion cell or battery as energy source.

The technology of the present invention possesses a great commercial value for improving the capacity, average operating voltage and specific energy of the secondary lithium ion cell, and makes a certain contribution to the research of the

basic theory of lithium ion cell. It is believable that the present technology could improve the development of the whole secondary lithium ion cell industry.

CLAIMS:

1. A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that the charge cut-off voltage of the singe cell is greater than 4.2 V but less than 5.8 V, preferably within a range from 4.3 V to 5.2 V, and more preferably within a range from 4.3 V to 4.8 V; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.

2. A secondary lithium ion cell or battery, characterized in that the single secondary lithium ion cell has an charge cut-off voltage of greater than 4.2 V but less than 5.8 V, preferably within a range from 4.3 V to 5.2 V, and more preferably within a range from 4.3 V to 4.8 V; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by theoretic capacity.

3. A secondary lithium ion cell of battery according to claim 2, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V.

4. A protecting circuit for the secondary lithium ion cell or battery according to claims 2 or 3, characterized in that the single lithium ion cell of said protecting circuit has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V.

5. An electronic device using a secondary lithium ion cell or battery as energy source, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V.

6. A charging device for a secondary lithium ion cell or battery, characterized in that said charging device controls an charge cut-off voltage to the single lithium ion cell within the range of greater than 4.3 V but less than 5.8 V, preferably within the range from 4.3 V to 5.2 V, and more preferably within the range from 4.3 V to 4.8 V.

ABSTRACT

The present invention provides a new method for improving capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery. This method is achieved by means of properly adjusting the ratio between a positive material and negative material, which is calculated by theoretical specific energy, and properly increasing charge cut-off voltage. The present method can greatly increasing specific energy and average operating voltage of a secondary lithium ion cell without influence on recycle property of the cell. The present invention also provides a secondary lithium ion cell or battery practicing the method, a protecting circuit adapted for the secondary lithium ion cell or battery, a electronic device using said protecting circuit and said secondary lithium ion cell or battery, and a charging device for the secondary lithium ion cell or battery.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Xiaoping REN et al.

Title: *SECONDARY LITHIUM ION CELL OR ATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME*

Intl Appl. No.: CN02/00696 filed 09/28/2002

Serial No.: Unassigned

Filed: March 26, 2004

PRELIMINARY AMENDMENT

Mail Stop NON-FEE AMENDMENT
Commissioner for Patents
PO Box 1450
Alexandria, Virginia 22313-1450

Sir:

Prior to the examination of the application, Applicant respectfully requests that the application be amended as follows:

Amendments to the Claims begin on page 2 of this document.

Remarks/Arguments begin on page 5 of this document.

Please amend the application as follows:

Complete Listing of the Claims:

Please amend the claims as follows:

1. (Amended) A method for improving the capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery, characterized in that the charge cut-off voltage of the singe cell is greater than 4.2 V but less than 5.8 V~~, preferably within a ranger of 4.3 V to 5.2 V, and more preferably within a ranger from 4.3 V to 4.8 V~~; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, ~~preferably from 1:1.15 to 1:2.~~5, as calculated by the specific capacity with the charge voltage limited to 4.2 V.

2. (Amendedl) ~~A secondary lithium ion cell or battery, characterized in that the single secondary lithium ion cell has an charge cut-off voltage of greater than 4.2 V but less than 5.8 V, preferably within a range from 4.3 V to 5.2 V, and more preferably within a range of 4.3 V to 4.8 V; and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, preferably from 1:1.15 to 1:2.5, as calculated by theoretic capacity~~ A method according to claim 1, characterized in that the charge cut-off voltage of the singe cell is within a range from 4.3 V to 5.2 V.

3. (Amended) ~~A secondary lithium ion cell of battery according to claim 2, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V~~ A method according to claim 1, characterized in that the charge cut-off voltage of the singe cell is within a range from 4.3 V to 4.8 V.

4. (Amended) ~~A protecting circuit for the secondary lithium ion cell or battery according to claims 2 or 3, characterized in that the single lithium ion cell of said protecting circuit has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.15 V, preferably a first overcharging protection voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V~~ A method according to claim 1, characterized in that the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.15 to 1:2.5.

5. (Amended) ~~An electronic device using a secondary lithium ion cell or battery as energy source, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge release voltage of greater than 4.45 V, and an overcharge release voltage of greater than 4.25 V~~ A secondary lithium ion cell or battery, characterized in that the single secondary lithium ion cell has a charge cut-off voltage of greater than 4.2 V but less than 5.8 V, and the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.0 to 1:2.5, as calculated by the theoretic capacity with the charge cut-off voltage set at 4.2 V.

6. (Amended) ~~A charging device for a secondary lithium ion cell or battery, characterized in that said charging device controls an charge cut-off voltage to the single lithium ion cell within the range of greater than 4.3 V but less than 5.8 V, preferably within the range from 4.3 V to 5.2 V, and more preferably within the range from 4.3 V to 4.8. V~~ A secondary lithium ion cell or battery according to claim 5, characterized in that the single secondary lithium ion cell has a charge cut-off voltage within a range from 4.3 V to 5.2 V.

7. (New) A secondary lithium ion cell or battery according to claim 5, characterized in that the single secondary lithium ion cell has a charge cut-off voltage within a range from 4.3 V to 4.8. V.

8. (New) A secondary lithium ion cell or battery according to claim 5, characterized in that the ratio of positive electrode material to negative electrode material of the single cell is from 1:1.15 to 1:2.5.

9. (New) A secondary lithium ion cell or battery according to claim 5, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V.

10. (New) A secondary lithium ion cell or battery according to claim 9, characterized in that the single lithium ion cell has a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

11. (New) A protecting circuit for the secondary lithium ion cell or battery according to claim 5, characterized in that the single lithium ion cell of said protecting circuit has a first overcharge protection voltage of greater than 4.35 V, and an overcharging protection release voltage of greater than 4.15 V.

12. (New) A protecting circuit according to claim 11, characterized in that the single lithium ion cell of said protecting circuit has a first overcharge protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

13. (New) An electronic device using a secondary lithium ion cell or battery as energy source, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.35 V, and an overcharge protection release voltage of greater than 4.15 V.

14. (New) An electronic device according to claim 13, characterized in that said electronic device comprises a protecting circuit, wherein the single lithium ion cell has a first overcharging protection voltage of greater than 4.45 V, and an overcharge protection release voltage of greater than 4.25 V.

15. (New) A charging device for a secondary lithium ion cell or battery, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range of greater than 4.3 V but less than 5.8 V.

16. (New) A charging device according to claim 15, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range from 4.3 V to 5.2 V.

17. (New) A charging device according to claim 15, characterized in that said charging device controls a charge cut-off voltage to the single lithium ion cell within the range from 4.3 V to 4.8 V.

REMARKS

Applicant respectfully requests that the foregoing amendments be entered prior to examination of the present application, on the merits.

Applicant has amended claims 1-6 and added new claims 7-17, to cancel multiply dependent claims and correct non-complying claim formats of the international application. These amendments do not narrow the scope of the claims presented for examination.

If there are any questions about this submission, the Examiner is invited to contact the undersigned by telephone.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 19-0741.

Respectfully submitted,

Date March 29, 2004

By [signature] Reg No 37,258
for Stephen A. Bent
Attorney for Applicant
Registration No. 29,768

FOLEY & LARDNER, LLP
Customer Number: 22428
22428
22428
PATENT TRADEMARK OFFICE
Telephone: (202) 672-5404
Facsimile: (202) 672-5399

Application Data Sheet

Application Information

Application Type::	Regular
Subject Matter::	Utility
Suggested classification::	
Suggested Group Art Unit::	
CD-ROM or CD-R?::	None
Computer Readable Form (CRF)?::	No
Title::	SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME
Attorney Docket Number::	042787-0106
Request for Early Publication?::	No
Request for Non-Publication?::	No
Suggested Drawing Figure::	
Total Drawing Sheets::	
Small Entity?::	Yes
Petition included?::	No
Secrecy Order in Parent Appl.?::	No

Applicant Information

Applicant Authority Type::	Inventor
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Correspondence Information

Correspondence Customer Number::	22428
E-Mail address::	PTOMailWashington@Foley.com

Representative Information

Representative Customer Number::	22428	

Domestic Priority Information

Application::	Continuity Type::	Parent Application::	Parent Filing Date::
This Application	National Stage of	PCT/CN02/00696	9/28/2002

Foreign Priority Information

Country::	Application number::	Filing Date::	Priority Claimed::
China P.R.	01141615.7	9/28/2001	Yes

Assignee Information

Assignee name::

Pat Booklet

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET
(FOR USE WITH FORM PTO-875)

SERIAL NO. 10/491134 | FILING DATE

APPLICANT(S)

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
1			1			
2				1		
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TOTAL IND.			4			
TOTAL DEP.			13			
TOTAL CLAIMS			17			

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	IND.	DEP.	IND.	DEP.	IND.	DEP.
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100						
TOTAL IND.						
TOTAL DEP.						
TOTAL CLAIMS						

PTO-1360 (3-78)

*MAY BE USED FOR ADDITIONAL CLAIMS OR AMENDMENTS

U.S. DEPARTMENT of COMMERCE
Patent and Trademark Office

PATENT APPLICATION SERIAL NO. 10/491134

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

04/05/2004 GFREY1 00000028 10491134

01 FC:2611	540.00	OP
02 FC:2617	65.00	OP
03 FC:2614	43.00	OP

PTO-1556
(5/87)

*U.S. Government Printing Office: 2002 — 489-267/69033

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2003

Application or Docket Number
10/491134

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS		
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	17 minus 20=	*
INDEPENDENT CLAIMS	4 minus 3 =	* 1
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☑		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	540	OR	BASIC FEE	
XS 9=		OR	XS18=	
X43=	43	OR	X86=	
+145=		OR	+290=	
TOTAL	583	OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
XS 9=		OR	XS18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X43=		OR	X86=	
+145=		OR	+290=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. 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 number found in the appropriate box in column 1.

FORM PTO-875 (Rev 10-03)
Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

DT02 Rec'd PCT/PTO 29 MAR 2004

FORM PTO-1390 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE (REV 5-93)

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: 042787-0106

U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5): Unassigned 10/491134

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
CN02/00696	9/28/2002	9/28/2001

TITLE OF INVENTION: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

APPLICANT(S) FOR DO/EO/US: Xiaoping REN et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   - ☐ is attached hereto (required only if not communicated by the International Bureau).
   - ☒ has been communicated by the International Bureau.
   - ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   - ☐ is attached hereto.
   - ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   - ☐ are attached hereto (required only if not transmitted by the International Bureau).
   - ☐ have been communicated by the International Bureau.
   - ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   - ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A preliminary amendment.
14. ☒ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☐ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.2 and 37 CFR 1.821 – 1.825
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☐ Other items or information:

002.174199.1 FORM PTO-1390 (Modified)

D111 Rec'd PCT/PTO 29 MAR 2004

O. (If known, see 37 C.F.R. 1.50	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
Unassigned 10/491134	CN02/00696	042787-0106

21. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
BASIC NATIONAL FEE (37 CFR 1.492(a)(1)-(5):		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO.....$1,080.00		
International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO.....$920.00		
No international preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....$770.00		
International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4).....$730.00		
International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4).....$100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$ 1080.00	
Surcharge of $130.00 for furnishing the oath or declaration later than 30 months from the earliest claimed priority date (37 CFR 1.492(e))	$ 130.00	

CLAIMS	NUMBER FILED		NUMBER EXTRA	RATE		$	
Total Claims	17	- 20 =	0	x $	18.00	$ 0.00	
Independent Claims	4	- 3 =	1	x $	86.00	$ 86.00	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+ $	290.00	$	
				TOTAL OF ABOVE CALCULATIONS =		$ 1296.00	
☒ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by ½.					+	$ 648.00	
				SUBTOTAL =		$ 648.00	
Processing fee of 130.00 for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(f)).						$	
				TOTAL NATIONAL FEE =		$ 648.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). 40.00 per property						$	
				TOTAL FEES ENCLOSED =		$ 648.00	
						Amount to be refunded:	
						charged:	

a. ☒ A check in the amount of $ 648. to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. 19-0741 in the amount of 648 to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 19-0741. A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charge to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

Foley & Lardner LLP

Customer Number: 22428

Cristina Brueckner Reg No 37,784
SIGNATURE

Stephen A. Bent
NAME

29,768
REGISTRATION NUMBER

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
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 displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 10/491,134	Filing Date 05/06/2004	☐ To be Mailed

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	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 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			TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	03/29/2004	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	* 17	Minus	** 20	= 0	X $9 =	0	OR	X $ =	
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X $43 =	0	OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE	0	OR	TOTAL ADD'L FEE	

		(Column 1)		(Column 2)	(Column 3)					
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	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 number found in the appropriate box in column 1.

Legal Instrument Examiner:
/LINDA W. BADIE/

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.

10/491134

PCT/CN02/00696

证　　明

REC'D 18 NOV 2002

本证明之附件是向本局提交的下列专利申请副本

申　请　日：2001 09 28

申　请　号：01 1 41615.7

申请类别：发明

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

发明创造名称：二次锂离子电池或电池组、其保护电路以及电子装置

申　请　人：任晓平；孙杰

发明人或设计人：任晓平；孙杰

BEST AVAILABLE COPY

中华人民共和国
国家知识产权局局长 王景川

2002 年 10 月 15 日

权 利 要 求 书

1. 提高二次锂离子电池或电池组的容量、平均工作电压和比能量的方法，其特征在于对该单体锂离子电池的充电限制电压大于 4.2V，但不超过 5.8V，优选该充电限制电压在 4.3V～5.2V，更优选在 4.3V～4.8V；单体锂离子电池的正、负极的配比按充电限制电压为 4.2V 时的理论克容量计算在 1：1.0～1:2.5，优选该配比在 1：1.15～1:2.5。

2. 二次锂离子电池或电池组，其特征在于该单体锂离子电池的充电限制电压大于 4.2V，但不超过 5.8V，优选该充电限制电压在 4.3V～5.2V，更优选在 4.3V～4.8V；其单体锂离子电池的正、负极的配比按理论克容量计算在 1：1.0～1:2.5，优选该配比在 1：1.15～1:2.5。

3. 如权利要求 2 所述的二次锂离子电池或电池组，其特征在于单体锂离子电池首次过充保护电压大于 4.35V，过充保护释放电压大于 4.15V，优选在其首次过充保护电压大于 4.45V，过充保护释放电压大于 4.25V。

4. 用于权利要求 2 或 3 的二次锂离子电池或电池组的保护电路，其特征在于其单体锂离子电池首次过充保护电压大于 4.35V，过充保护释放电压大于 4.15V，优选在其首次过充保护电压大于 4.45V，过充保护释放电压大于 4.25V。

5. 以二次锂离子电池或电池组为能源的电子装置，其特征在于该电子装置具有使单体锂离子电池的首次过充保护电压大于 4.35V、过充保护释放电压大于 4.15V 的保护电路，优选在其首次过充保护电压大于 4.45V，过充保护释放电压大于 4.25V。

说　明　书

二次锂离子电池或电池组、其保护电路以及电子装置

技术领域

本发明涉及提高二次锂离子电池或电池组的容量、平均工作电压和比能量的方法，同时也涉及采用该方法制备的二次锂离子电池或电池组，以及用于所述二次锂离子电池或电池组的保护电路和使用所述二次锂离子电池或电池组的电子装置。

背景技术

自 1990 年，日本 Sony 公司发明研制出二次锂离子电池并商品化以来，锂离子电池产业得到迅猛发展，至 2000 年，全球各大锂离子电池制造商为了提升产品的竞争力，针对提高锂离子电池容量这一技术核心展开了全面竞争。目前已商品化的二次锂离子电池容量的提升主要是依靠增加活性物质（正负极材料）的填充量来予以实现，然而锂离子电池体积的有限性使电池的容量的提升受到了极大地限制。开发比能量更高的活性物质（正负极材料），大幅提升电池容量的科研工作已在全球范围内展开，但到目前为止，在技术上还没有大的突破，并存在许多技术上的障碍。

其实，目前的二次锂离子电池的正负极材料已经具有相当高的理论克容量，只是实际利用的效能太低。如：作为二次锂离子电池正极材料的钴酸锂，其理论克容量高达 248mAh/g，而实际使用的克容量才达 120mAh/g 左右，也就是说还有一半的潜能没有发挥出来，其原因之一是目前使用的充电限制电压较低。目前二次锂离子电池制造业中公认的行业技术要求是将单体二次锂离子电池充电限制电压限于不超过 4.2V，并且，现今在世界各国上市的锂离子电池均是在这一技术要求下生产制造出来的。如：单体锂离子电池在化成工艺处理过程中，充电限制电压为 4.2 伏以下，其保护电路的过充保护释放电压控制在 4.15 伏以下。将充电限制电压控制在 4.2 伏的原因，是以往的研究成果和大量的文献报道

认为：提高充电限制电压，虽然可以提高锂离子电池的容量和平均工作电压，但当充电限制电压大于 4.2 伏时，锂离子电池的正负极材料结构会发生变化，电解液也会发生分解，从而影响电池的循环性能。

例如，对于目前商业化的锂离子电池大多用作正极材料的钴酸锂而言，虽然许多文献显示以锂金属作为对电极制成实验电池时的充电限制电位可以在 4.2V 以上，但在以钴酸锂为正极的商品化锂离子电池中，充电限制电压都在 4.2V 以下，从而使钴酸锂的实际克容量为 120-130 毫安时/克，即仅仅是理论容量的 50%左右。实际上，根据 MIZUSHIMAK 等人的报道 "具有高能量密度的新型阴极材料"(A new cathode material for batteries of high energy density. MaterResBull. 1980, 15:783): 锂离子的脱出量随充电电压的升高而升高，钴酸锂的电化学克容量也会随之升高。但是，研究认为以金属锂作为对电极钴酸锂的可逆充放电位在 4.3V 左右，超过 4.3V 钴酸锂的结构会发生变化，晶格参数 C 会由 4.4 纳米降至 4.0 纳米，钴酸锂的结构因之发生变化，影响电池的循环寿命。

G. PISTOIA 等人(J Power Source, 56(1995), 37-43.)认为钴酸锂的结构会随着充电电压的变化而变化，超过一定电压会出现单斜相与六方相共存的情况。此时会影响电池的循环性能，造成电池循环性能的下降。实验发现，在以锂金属作为负极的扣式实验电池中，当充电限制电压提高至 4.35V 时，钴酸锂的克容量可以达到 159 毫安时/克。但循环几周后，就下降至 135 毫安时/克。充电限制电压为 4.25V 时，容量衰减也很快。文献认为只有当充电限制电压在 4.15V 时，钴酸锂保持良好的循环性能，克容量保持在 130 毫安时/克左右。但是单斜相对应的电位是 4.05V，六方相所对应的电位是 4.17V，都在 4.2V 以内。

还有文献（雷永泉主编《新能源材料》，2000P136）给出了用 EC/DMC 的作为混合溶剂，用 LiPF6 作为电解质的电解液在铝箔集流体上的分解电位是 4.2V。由此认为充电限制电压超过 4.2V 以上时会分解电解液，影响电池的循环寿命。

1990 年 SONY 公司推出以焦碳作为负极的锂离子电池，充电限制电压为 4.20V 以下，此成为以后锂离子电池公认的技术要求。

这是因为，现有技术认为：

1. 充电限制电压的提高会使正极物质的结构发生改变，结构的改变又集中在两个方面，其中一方面结构的变化主要是相的变化即六方相和单斜相的转变与共存，会严重影响锂离子电池的循环寿命。另一方面是晶格参数的变化会使锂离子进出的通道变窄，从而使锂离子所占的空隙受到挤压，进而堵塞锂离子的通道，降低锂离子电池的循环性能。

2. 提高充电限制电压会使电解液在高电位下发生分解，电解液的减少又会使锂离子的传输变得困难，从而严重影响电池的循环寿命。

从中可以看出，对于锂离子二次电池，由于充电电压的限制，限制了电极活性材料实际的有效利用率，在此条件下即使今后开发出了比能量更高的正负极材料，锂离子电池也无法发挥出最佳的效能。因此，迫切需要一种提升锂离子电池活性物质的效能利用率，进而提高电池容量和平均工作电压，同时保持较好的电池性能的方法。

发明内容

针对本领域中普遍认为将充电限制电压提高到高于 4.2 伏以后会大幅度降低电池的循环寿命这一观点，本发明人围绕提高充电限制电压，提升电池容量做了大量相关实验和研究。与上述观点相反，本发明人出人意料地发现，通过提高充电限制电压，并适当调整单体锂离子电池的正、负极的配比，可以大大提高二次锂离子电池中电极活性材料的利用率，从而提高二次锂离子电池或电池组的比能量、容量和平均工作电压，而基本不改变电池的性能。本发明正是基于上述发现而得以完成的。

本发明的一个目的是提供提高二次锂离子电池或电池组的比能量和平均工作电压的新方法，其中该单体电池的充电限制电压大于 4.2V，但不超过 5.8V，单体锂离子电池的正、负极的配比按充电限制电压为 4.2V 的理论克容量计算在 1： 1.0～1:2.5，优选在 1： 1.15—1： 2.5。

本发明另一个目的是二次锂离子电池或电池组，该单体二次锂离子电池的充电限制电压大于 4.2V，但不超过 5.8V，其单体锂离子电池的正、

负极的配比按充电限制电压为 4.2V 的理论克容量计算为 1: 1.0～1:2.5，优选该配比在 1: 1.15～1:2.5。

本发明又一个目的是用于上述二次锂离子电池或电池组的保护电路，该保护电路的首次过充保护电压大于 4.35V，过充保护释放电压大于 4.15V。

本发明再又一个目的是以二次锂离子电池或电池组为能源的电子装置，该电子装置包括使单体锂离子电池的首次过充保护电压大于 4.35V、过充保护释放电压大于 4.15V 的保护电路。

实施本发明具体方式

与本领域中普遍认为应该将充电限制电压限于 4.2 伏相反，本发明人通过逐步提高充电限制电压，并适当调整单体锂离子电池的正、负极的配比，在考察提高充电限制电压后的电池性能的大量实验中，出乎意料地发现，能够在基本不改变其它电池特性的同时，可以低成本地显著提高二次锂离子电池或电池组的容量、比能量和平均工作电压。在本发明中，"锂离子电池或电池组"是指本发明既可应用于锂离子单体电池，也可应用于包括保护电路的单体锂离子电池，也可应用于包括多个单体锂离子电池的电池组，也可应用于包括多个单体锂离子电池及保护电路的电池组，为了简便起见，有时也统称为"锂离子电池"。此外，本发明中"正、负极材料的理论克容量"是指正、负极材料按照充电限制电压为 4.2V 时的理论克容量。

本发明人通过逐步提高充电限制电压，研究了充电限制电压与二次锂离子电池的电池特性的关系。例如，在试验中，在对市售二次单体锂离子电池进行检测及自制二次单体锂离子电池化成检测时，本发明人将充电限制电压的工艺参数由 4.2 伏，提高至 4.30 伏、4.35 伏、4.40 伏、4.45 伏和 4.6 伏。结果发现，在充电限制电压为 4.3 伏、4.35 伏、4.40 伏时，其比能量比充电限制电压为 4.2 伏时提高了约 6-20%，电池仍然可以保护良好的循环性能，循环 50 次，容量保持在 95%以上，循环 500 次，容量保持在 80%以上，和充电限制电压在 4.2 伏时的循环性能相当。然而

在充电限制电压提高至4.45伏以上时，比能量虽然提高了近30%，但循环性能较差，循环6次后，容量保持率仅为83.9%。

为了找出充电限制电压提高至4.45伏以上时循环性能较差的原因，本发明人在做了大量基础研究和理论探索后，调整了正负极材料容量配比，即：将锂离子电池的正负极材料按充电限制电压为4.2V时的理论克容量计算的配比调整为1：1.3～2.5。之后将正、负极材料容量配比调整后的单体锂离子电池，分别在充电限制电压为4.45伏、4.6伏，4.8伏、5.0伏、5.2伏、5.4伏、5.6伏、5.8伏时进行充电试验，优选在化成、检测时进行该充电试验。其实验结果显示，在适当的正负极材料配比下，充电限制电压为4.45伏以上时，电池的比能量可以大幅提高，而电池的循环性能基本不会受到影响。

本发明方法中对提高充电电压的操作优选在电池化成、检测时进行。因为将电池的充电限制电压提高至4.20V以上，既提高了电池的比能量，提高了正极活性物质的克容量，提高了电池的平均工作电压，又对电池进行了活化，使其可以达到最佳使用状态。既起到原有的化成工艺所应具有的效果，又可以极大提高锂离子电池的比能量从而起到一举两得的效果。达到了既不改变原有工艺流程，又提高了目前商品化锂离子电池的比能量，增强锂离子电池竞争力的目的。

形成以上实验结果的机理还需进一步研究，不希望为任何理论所限制，在此推测可能的原因有：

1.充电限制电压提高后，使锂离子从正极材料中脱出的比例大幅度提高，造成了与原来负极材料容量的不匹配，使过多的锂离子在负极表面沉积成金属锂，从而堵塞住锂离子进出的一部分通道，造成容量衰减，影响循环性能。增大负极材料容量，满足了相对过多的锂离子嵌入的需要，因此避免了锂离子在负极表面沉淀成金属锂，使电池的荷电保持性能和循环性能没有受到影响。选择合适的正负极配比可以避免金属锂沉积在负极表面，从而避免堵塞了锂离子进出的通道被堵塞，从而避免锂离子电池容量的衰减。尤其当锂离子电池充电限制电压大于4.45V时，原有的锂离子电池的负极更加呈现出不足状态，过多的锂离子会在负极

表面沉积成金属锂，从而堵塞住锂离子进出的一部分通道，造成容量的衰减。较大幅度提高负极的含量，可望减少锂离子电池容量因循环次数的增多而造成的衰减。依照此思路，我们作了系列实验，实验结果证明了我们的推测（见实施例）。

2. 充电限制电压控制在一定范围内，极少量的电解液分解对电池的循环性能影响极小。使用高分解电位的电解质会有更好的表现，或加入可以提高电解液分解电位的添加剂。电解液的分解主要是发生在正极上，虽然文献认为，以 $LiPF_6$ 为电解质，以 EC/DMC 混合液作为溶剂的电解液在铝箔表面的分解电压为 4.2V，但是从实验结果来看，这一因素对目前已商品化的锂离子电池的循环寿命基本没有影响。可以认为即使电解液在高于 4.2V 的电压发生了分解，由于电能主要用来转化成化学能，所以能用与分解电解液的电能是微不足道，而这一部分电解液的分解对锂离子电池的循环寿命几乎没有影响。至于在分解电位以上的电压范围如 5.0V 以上，也可以加入物质 A 或采用具有更高分解电位的电解液体系 B。表 1 列出了目前所用的电解液组分的分解电位，从中可以看出溶剂的最低分解电压也在 4.5V 以上。

表 1 各种混合电解液的分解电位

溶质	$LiCLO_4$	$LiAsF_6$	$LiPF_6$
混合溶剂	分解电位(V)	分解电位(V)	分解电位(V)
PC:DME	4.51	4.72	
PC:DEC	4.5	4.5	
PC:EC		4.5	
PC:EC:DME	4.5	4.62	
PC:DEC:2MLF		4.52	
EC:DEC		4.9	4.8
EC:DMC			4.9
B			5.9

3. 充电限制电压提高至 4.2V 以上，锂离子电池之所以未出现文献所述的由于结构变化造成的容量衰减，可能是因为：由于第一次锂离子脱

出以后，有约 10%左右的锂离子用以形成钝化膜，从而使锂离子的实际空隙多于锂离子所应占的空隙，锂离子所拥有的空隙大于处于活化状态锂离子所需占用空隙的 10%左右，虽然电压的提高会改变正极材料的结构，使晶格变小，但是由于实际脱出和嵌入的锂离子所占的空隙少于正极活性物质所实际具有的空隙，所以一定范围的结构变化不会使锂离子在脱出和嵌入的过程中受阻，也就不会影响电池的循环寿命。使用结构随电位变化更稳定的正、负极材料会有更好的表现。虽然正极过充电会产生不导电的惰性物质。但从实验结果来看，只有当锂离子完全脱出来时才有可能，例如对于钴酸锂，镍酸锂及掺杂的钴酸锂，镍酸锂而言，用 3C5A 的电流充电时，实验数据显示只有当电池电压在 6.20V 左右时锂离子才会完全脱出，大量释放氧气，形成绝缘体，而对于锰酸锂及掺杂的锰酸锂，采用同样的充电电流，锂离子完全脱出时电池电位一般为 6.50V 左右。一般情况下由于目前商业化锂离子电池所用的正极活性物质的实际比能量远远低于理论比能量，即使充电限制电压提高至 5.8V，在选用适当的配方的前提下，也没有达到其理论容量，因而不存在过充电的问题。所以本发明的方法仍然具有很大的安全性。

4. 除以上因素外，电池的自放电大小，集流体选用，钝化膜形成都会影响锂离子电池的循环寿命，而这些因素主要取决于锂离子电池的制造工艺。可以肯定，在选择了较优的制作工艺之后，采用本发明的方法可以大幅度地提高锂离子电池的容量、平均工作电压、比能量，而不会影响锂离子电池的循环寿命以及其他性能。

因此，本发明提供了一种新颖的有效提高二次锂离子电池或电池组的比能量和平均工作电压的方法，在该方法中，与现有技术相反，当通过将单体锂离子电池的充电限制电压提高到大于 4.2V 但不超过 5.8V，并且单体锂离子电池的正、负极的配比按理论克容量计算在 1: 1.0～1:2.5 时，可以提高电极活性材料的利用效率，从而提高电池的容量、能量密度和输出电压，同时又不损害电池的使用性能。为了取得较好的效果，本发明还优选该充电限制电压在 4.3V～5.2V，更优选在 4.3V～4.8V。此外，本发明优选将单体锂离子电池的正、负极的配比按充电限制电压为

4.2V 时的理论克容量计算限制在 1: 1.15~1:2.5 的范围。试验表明，当采用的工艺参数超出上述配比范围时，电池性能变差，不适合使用。当负极与正极的配比按理论克容量计算小于 1.0 时，电池循环寿命过分降低，当负极与正极的配比按理论克容量计算大于 2.5 时，电池的体积效率显著降低。另外，当提高充电限制电压超过 5.8V 以后，电池特性变差，不适合使用。

从中可以看出，通过适当调整正、负极材料按照理论克容量计算的配比和适当提高充电限制电压，可以在不影响电池循环性能的前提下，大幅度提高二次锂离子电池的容量、比能量和平均工作电压，使锂离子电池更具商业价值和更广的应用范围。因此，可以认为本发明方法还优化了正负极活性材料的利用率，从而它也是一种经济的方法。本发明人有理由相信，今后即使开发出了具有更高比能量的正负极材料，本技术仍然可以使其提高效能利用率，达到最佳的使用效果。

此外，值得指出的是，采用本发明的方法，并不会使电池工作于极端的工作状态。经过反复试验，本发明人从未发现本发明方法会造成电池损毁的概率增加。因此，本发明方法还是一种安全的方法。

此外，本发明还提供比能量和平均工作电压得到提高的新颖的二次锂离子电池或电池组，在该二次锂离子电池或电池组中，与现有技术相反，所述单体锂离子电池的充电限制电压大于 4.2V 但不超过 5.8V，并且单体锂离子电池的正、负极的配比按充电限制电压为 4.2V 时理论克容量计算在 1: 1.0~1:2.5，与现有技术二次锂离子电池或电池组相比，该二次锂离子电池或电池组的容量、能量密度和输出电压得到大幅度提高，同时还具有与现有技术电池相当的循环寿命。为了取得较好的效果，本发明还优选所述充电限制电压在 4.3V~5.2V，更优选在 4.3V~4.8V。此外，优选将所述单体锂离子电池的正、负极的配比按充电限制电压为 4.2V 时的理论克容量计算限制在 1: 1.15~1:2.5 的范围。试验表明，当该二次锂离子电池或电池组的电池参数超出上述配比范围时，电池性能变差，不适合使用。当负极与正极的配比按理论克容量计算小于 1.0 时，电池循环寿命过分降低，当负极与正极的配比按理论克容量计算大于 2.5 时，

电池的体积效率显著降低。另外，当提高充电限制电压超过 5.8V 以后，电池特性变差，不适合使用。

另外，重要的是，本发明的方法不仅适用于本发明的二次锂离子电池或电池组，而且，还可应用于按现有技术方法得到的二次锂离子电池或电池组，例如目前商品化的二次锂离子电池或电池组。

以下以非限制方式更具体地介绍适用于本发明方法的二次锂离子电池。二次锂离子电池的一般结构包括：正极、负极、非水电解质和将正极与负极相互隔开的隔膜组成。非水电解质通过将含锂的金属盐例如 $LiPF_6$ 作为电解质溶解在例如碳酸亚乙酯或碳酸二甲酯的非水溶剂中而得到。隔膜在上述非水溶剂中不溶解，并且是由例如聚乙烯或聚丙烯树脂制成的多孔膜。其中，本发明中单体锂离子电池正负极活性物质比例按照充电限制电压为 4.2V 时的正负极活性物质的理论克容量来计算。

正极

正极制备可例如采用通过将正极活性材料、导电剂和粘合剂在适当溶剂中悬浮而制成的悬浮液涂覆集流器例如铝箔上，接着干燥并压制涂覆过悬浮液的集流器而获得。

本发明中电池正极活性物质为含锂元素的化合物。虽然在实施例中本发明使用了钴酸锂（即锂钴复合氧化物）、锰酸锂和镍酸锂作为正极活性材料进行了描述，但是应该理解，本发明的实施并不依赖于所述含锂复合氧化物的特性，而可以广泛地适用于各种正极活性材料。他们的共同特点也是比能量随着电位的升高而提高，通过实验证明（见实施例），充电限制电压提高至 4.20V 以上时，电池的容量可以大幅度提高，不影响电池的其他性能。同样本发明也适用于以各种掺杂型的含锂元素作为正极活性物质的锂离子电池，如包括各种氧化物和硫化物的正极活性材料，其实例包括例如，锂钴复合氧化物、锂锰复合氧化物、锂镍复合氧化物、锂镍钴复合氧化物、锂锰钴复合氧化物、和钒氧化物。在这些正极活性材料中，优选使用具有高电池电压的锂钴复合氧化物（例如 $LiCoO_2$）、锂锰复合氧化物（例如 $LiMn_2O_4$）、锂镍复合氧化物（例如 $LiNiO_2$）、锂镍钴复合氧化物（例如 $LiNi_{1-x}Co_xO_2$）、锂锰钴复合氧化物（例如 $LiMn_xCo_{1-x}O_2$）。

此外，本发明可使用公知的导电剂和粘合剂。正极活性材料中各组分的混合比例可使用公知的比例范围。

隔膜

本发明所用的隔膜是公知的隔膜，例如可以是由合成树脂的无纺布、聚乙烯多孔膜或聚丙烯多孔膜以及由此类材料复合而成的材料制成的类型。

负极

负极制备可例如采用通过将负极活性材料、导电剂和粘合剂在适当溶剂中悬浮而制成的悬浮液涂覆集流器例如铜箔、镍箔或不锈钢箔上，接着干燥并压制涂覆过悬浮液的集流器而获得。

本发明中电池负极活性物质为锂离子能在其中嵌入和脱出的碳系和非碳系的物质，包括，例如，锂合金（例如，$Li_4Ti_5O_{12}$）、金属氧化物（例如非晶态锡氧化物、WO_2和MoO_2）、TiS_2以及能吸收和去吸收锂离子的碳系物。特别希望使用碳系物充当负极活性材料。

本发明所用的碳系物包括，例如，石墨、无取向性石墨、焦炭、碳纤维、球形碳、树脂烧结碳和汽相生长碳，纳米碳管。因为包含如上所述的特定碳纤维或球形碳的负极表现出高充电效率，特别希望使用中间相沥青基碳纤维或中间相沥青基球形碳充当碳素物。中间相沥青基碳纤维和中间相沥青基球形碳可采用公知的方法获得。

非水电解质和外壳均可采用公知的类型和材料，并未特别限定，非水电解质，例如可以使用，在非水溶剂中溶解电解质而制成的液体非水电解质、将聚合物、非水溶剂和溶解物复合而制成的胶体非水电解质、聚合物固体非水电解质等等。

作为电池的结构可以是通过隔膜将阴极和阳极缠绕而形成螺旋状或通过隔膜使阴极和阳极层叠而形成层状结构，但是电池的结构并不限于特定的形状，可以制成例如柱状、棱形状、硬币状、钮扣式等形状。

对电池的充放电操作除电压采用本发明工艺参数外，均采用本领域公知的方式进行。

由于本发明使用的电压参数高于本领域目前采用的电压参数，因此需

要对应用了本发明方法或用于本发明的二次锂离子电池的保护电路和包括该电路的相关设备、装置进行改进。在此，不特别限定本发明用于上述二次锂离子电池或电池组的保护电路，可采用公知的结构类型，只要其首次过充保护电压大于 4.35V，过充保护释放电压大于 4.15V 即可。并且还优选首次过充保护电压大于 4.45V，过充保护释放电压大于 4.25V。

此外，不特别限定本发明的以二次锂离子电池或电池组为能源的电子装置，可采用公知的结构类型，只要其中该电子装置具有使单体锂离子电池的首次过充保护电压大于 4.35V、过充保护释放电压大于 4.15V 的保护电路即可；优选的首次过充保护电压大于 4.45V，过充保护释放电压大于 4.25V。本发明提供的电子装置包括，例如，笔记本型电子计算机、便携电话和掌上电脑（PDA），电动自行车，电动车等。

实施例

下面将根据具体的试验结果详细叙述本发明。

单体锂离子电池的制备

本发明一个实施例中，使用的单体锂离子电池制作过程如下：

采用铜箔作为负极的集流体，铝箔作为正极的集流体，正极活性物质用钴酸锂，负极活性物质用 MCMB。电池型号为方型 653466。将钴酸锂与 7%的黏合剂 PVDF 和 5%的导电碳黑混合，按 1：1 的比例加入 NMP 溶剂中。负极物质可以直接与 10%的黏合剂 PVDF 进行混合，按 1：1 的比例加入，制成浆料。将和好的正极浆料用涂敷的方法涂在正极的集流体上，负极浆料涂敷在负极集流体上，然后烘干，经过压制后，再进行涂敷处理。正极用涂敷浆料是将碳系材料和 PVDF 的混合后溶于有机溶剂制成。在烘干后的正极极片上，进行涂敷，涂敷后进行压制，然后烘干。

将烘干后的正负极片点上极耳，插入隔膜后，在卷绕机上卷绕后装入电池壳中，电池壳材料可以为铝材或钢材。隔膜为 PP 材料。将电池壳和电池盖用激光焊接的方法焊接在一起。在相对湿度小于 1.5%的环境下进行注液，电解液采用 EC：DEC：DMC=1：1：1 的混合溶剂，电解质为 1M 六氟磷酸锂，注液后立即封口。

实施例 1

按上述方法制成653466方型的多个锂离子电池，正负极配比分别为1:1.0、1:1.05、1:1.1、1:1.15、1:1.2、1:1.25、1:1.3，用4.20V作为充电限制电压进行化成、检测，上述电池的算术平均结果显示电池容量为1113毫安时，重量比能量为102瓦时/千克，平均工作电压为3.70V，循环400次容量保持85.72%。

实施例2

按上述方法制成653466方型的多个锂离子电池，正负极配比分别为1:1.0、1:1.05、1:1.1、1:1.15、1:1.2、1:1.25、1:1.3，用4.30V作为充电限制电压进行化成检测，上述电池的算术平均结果显示电池容量为1206毫安时，重量比能量为113瓦时/千克，平均工作电压为3.75V，循环400次容量保持86.31%。

实施例3

按上述方法制成653466方型的多个锂离子电池，正负极配比分别为1:1.0、1:1.05、1:1.1、1:1.15、1:1.2、1:1.25、1:1.3，用4.35V作为充电限制电压进行化成检测，上述电池的算术平均结果显示电池容量为1253毫安时，重量比能量为119瓦时/千克，平均工作电压为3.8V，循环400次容量保持84.79%。

实施例4

按上述方法制成653466方型的多个锂离子电池，正负极配比分别为1:1.0、1:1.05、1:1.1、1:1.15、1:1.2、1:1.25、1:1.3，用4.40V作为充电限制电压进行化成检测，上述电池的平均结果显示电池容量为1302毫安时，重量比能量为123瓦时/千克，平均工作电压为3.80V，循环400次容量保持83.93%。

实施例5

按上述方法制成653466方型锂离子电池，正负极配比为1:1.45，用4.45V作为充电限制电压进行化成检测，结果显示电池容量为1365毫安时，重量比能量为129瓦时/千克，平均工作电压为3.85V，循环400次容量保持84.56%。

实施例6

按上述方法制成653466方型锂离子电池，调整正负极比例为1：1.6，用4.60V作为充电限制电压进行化成检测，结果显示电池容量为1692毫安时，重量比能量为165瓦时/千克，平均工作电压为3.9V，循环400次容量保持85.13%。

实施例7

按上述方法制成653466方型锂离子电池，调整正负极比例为1：1.7，用4.80V作为充电限制电压进行化成检测，结果显示电池容量为1824毫安时，重量比能量为178瓦时/千克，平均工作电压为3.9V，循环400次容量保持83.92%。

实施例8

按上述方法制成653466方型锂离子电池，调整正负极比例为1：1.9，加入能提高分解电位的A物质或选择具有较高分解电位的电解液B，用5.00V作为充电限制电压进行化成检测，结果显示电池容量为1894毫安时，重量比能量为186瓦时/千克，平均工作电压为3.93V，循环400次容量保持81.23%。

实施例9

按上述方法制成653466方型锂离子电池，在正极浆料中加入15%另一种含锂元素的化合物C，调整正负极比例为1：2.2，用5.20V作为充电限制电压进行化成检测，结果显示电池容量为1962毫安时，重量比能量为194瓦时/千克，平均工作电压为3.96V，循环400次容量保持81.19%。

实施例10

按上述方法制成653466方型锂离子电池，在正极浆料中加入15%另一种含锂元素的化合物C，调整正负极比例为1：2.3，用5.40V作为充电限制电压进行化成检测，结果显示电池容量为1968毫安时，重量比能量为195瓦时/千克，平均工作电压为3.96V，循环400次容量保持81.19%。

实施例11

按上述方法制成653466方型锂离子电池，在正极浆料中加入15%另一种含锂元素的化合物C，调整正负极比例为1：2.4，用5.60V作为充电限制电压进行化成检测，结果显示电池容量为1970毫安时，重量比能量

为 195 瓦时/千克，平均工作电压为 3.96V，循环 400 次容量保持 79.97%。

实施例 12

按上述方法制成 653466 方型锂离子电池，在正极浆料中加入 15%另一种含锂元素的化合物 C，调整正负极比例为 1：2.5，用 5.80V 作为充电限制电压进行化成检测，结果显示电池容量为 1972 毫安时，重量比能量为 195 瓦时/千克，平均工作电压为 3.96V，循环 400 次容量保持 78.82%。

实施例 13

按上述方法制成 653466 方型锂离子电池，在正极浆料中加入 15%另一种含锂元素的化合物 C，调整正负极比例为 1：2.6，用 5.90V 作为充电限制电压进行化成检测，结果显示电池容量为 1565 毫安时，循环 15 次容量保持 12.31%。

从以上实施例可见，将充电电压提高到 4.2V 以上后，随着该电压提高，可提高电池容量和工作电压，重量比能量也提高了；当充电电压提高到 4.45V 以上后，随着该电压和正负极配比值的提高，可继续提高电池容量和工作电压和重量比能量；但是，该电压超过 5.8V 后，电池特性下降。

实施例 14－18

以锰酸锂为正极活性材料，按照与上述锂离子电池相同的制作方法，制备锂离子电池。其中正极浆料由 4 克的锰酸锂，0.6 克碳黑，0.32 克 PVDF，4.92 克 NMP 组成，负极浆料由 2.6 克 MCMB，0.26 克 PVDF，3.0 克 NMP 组成。电池型号为 063048 型方形锂离子电池具体实验数据见下表 2

表 2

实施例	充电限制电压（V）	工艺调整	循环性能	容量（毫安时）
14	4.20	无	400 次容量保持 84.23%	375
15	4.30	无	400 次容量保持 85.12%	405
16	4.60	正负极比例为 1：1.6	400 次容量保持 83.15%	575
17	5.80	正负极比例为 1：2.5，电解液中加入 A 物质。	400 次容量保持 82.83%	567
18	5.90	正负极比例为 1：2.7，电解液中加入 A 物质。	30 次容量保持 54.23%	312

实施例 14－18 显示采用锰酸锂基的正极活性材料仍取得与实施例 1－13 相似的结果。将充电电压提高到 4.2V 以上后，随着该电压提高，可提高电池容量和工作电压，重量比能量也提高了；当充电电压提高到 4.45V 以上后，随着该电压和正负极配比值的提高，可继续提高电池容量和工作电压和重量比能量；但是，该电压超过 5.8V 后，电池特性下降。

实施例 19－23

以镍酸锂作为正极活性材料，按照与上述以钴酸锂为正极活性材料的锂离子电池的制作方法相同的方法，制备锂离子二次电池，正极浆料由 4 克的镍酸锂，加入 0.2 克碳黑，0.2 克 PVDF，4.80 克 NMP 组成，负极浆料由 3.5 克 MCMB，0.35 克 PVDF，4.0 克 NMP 组成。电池型号为 063048 型方形锂离子电池具体实验数据见下表 3。

表 3

实施例	充电限制电压（V）	工艺调整	循环性能	容量（毫安时）
19	4.20		100 次容量保持 81.23%	610
20	4.30		100 次容量保持 80.72%	675
21	4.60	正负极比例为 1：1.6	100 次容量保持 78.32%	912
22	5.80	正负极比例为 1：2.5 电解液中加入 A 物质。	100 次容量保持 75.83%	879
23	5.90	正负极比例为 1：2.7 电解液中加入 A 物质。	50 次容量保持 47.53%	796

实施例 19－23 显示了采用镍酸锂基的正极活性材料仍取得与实施例 1－16 相似的结果。将充电电压提高到 4.2V 以上后，随着该电压提高，可提高电池容量和工作电压，重量比能量也提高了；当充电电压提高到 4.45V 以上后，随着该电压和正负极配比值的提高，可继续提高电池容量和工作电压和重量比能量；但是，该电压超过 5.8V 后，电池特性下降。

实施例 24－28

以掺钴的镍酸锂作为正极活性材料，按照与以钴酸锂为正极活性材料的锂离子二次电池相同的制作方法，制备锂离子二次电池。正极浆料由 4 克的镍酸锂，加入 0.2 克碳黑，0.2 克 PVDF，4.80 克 NMP 组成，负极浆料由 3.5 克 MCMB，0.35 克 PVDF，4.0 克 NMP 组成。电池型号为 063048 型方形锂离子电池具体实验数据见下表 4。

表 4

实施例	电限制电压(V)	工艺调整	循环性能	容量（毫安时）
24	4.20		400 次容量保持 81.23%	623
25	4.30		400 次容量保持 80.72%	682
26	4.60	正负极比例为 1: 1.6	400 次容量保持 78.32%	934
27	5.80	正负极比例为 1: 2.5 电解液中加入 A 物质。	400 次容量保持 75.83%	919
28	5.90	正负极比例为 1: 2.7 电解液中加入 A 物质。	50 次容量保持 39.53%	697

实施例 24－28 显示了采用掺杂含锂复合氧化物的正极活性材料仍取得与实施例 1－21 相似的结果。将充电电压提高到 4.2V 以上后，随着该电压提高，可提高电池容量和工作电压，重量比能量也提高了；当充电电压提高到 4.45V 以上后，随着该电压和正负极配比值的提高，可继续提高电池容量和工作电压和重量比能量；但是，该电压超过 5.8V 后，电池特性下降。这同时还说明本发明的方法不限于某种特定的含锂复合氧化物的正极活性材料，而可广泛地用于各种锂离子二次电池。

应用本发明方法，可以在锂离子电池生产工艺中及相关的产品改进中得到以下应用：

1. 单体锂离子电池在正负极材料按理论克容量计算获得最佳的容量匹配调整后，在化成检测时，将充电限制电压调整至大于 4.2V 但不超过 5.8 伏，可以获得循环性能很好的高容量二次锂离子电池，其优势在于：既起到原有化成工艺所应具有的效果，又可大幅提高锂离子电池的比能量和平均工作电压，而成本并未增加。对于锂离子电池制造商而言，可以大

幅提高利润率和企业竞争力；对于锂离子电池应用配套的产品而言，容量和平均工作电压的提高，可以使配套产品的性能也加以提升。

2. 建立在本发明技术基础上的单体二次锂离子电池的保护电路，其过充保护释放电压大于 4.15 伏，首次过充保护电压大于 4.35 伏。

3. 应用本发明技术制备的单体锂离子电池可以和上述具有本技术特征的保护电路组合生产出二次锂离子电池或电池组。

4. 具有本发明技术特征的保护电路可以应用于以二次锂离子电池或电池组为能源的移动电子装置和产品。

本发明技术对提高二次锂离子电池容量、平均工作电压及比能量，具有非常重大的商业价值，对丰富锂离子电池的基础理论研究有一定的贡献。相信本技术的推动力将贯穿二次锂离子电池产业的整体发展。

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(54) Title: SECONDARY LITHIUM ION CELL OR BATTERY, AND PROTECTING CIRCUIT, ELECTRONIC DEVICE AND CHARGING DEVICE OF THE SAME

(54) 发明名称: 二次锂离子电池或电池组、其保护电路、电子装置和充电装置

(57) Abstract: The present invention provides a new method for improving capacity, average operating voltage and specific energy of a secondary lithium ion cell or battery. This method is achieved by means of adequately adjusting the ratio between a positive material and negative material, which is calculated by theoretical specific energy, and adequately increasing end-of-charge voltage. Use of this method can greatly increasing specific energy and average operating voltage of a secondary lithium ion cell without influence on cycle character of the cell. The present invention also provides a secondary lithium ion cell or battery using the method, a protecting circuit adapted for the secondary lithium ion cell or battery, a electronic device using said protecting circuit and said secondary lithium ion cell or battery, and a charging device for the secondary lithium ion cell or battery.

(57) 摘要

本发明提供提高二次锂离子电池或电池组的容量、平均工作电压和比能量的新方法，通过适当调整正、负极材料按照理论克容量计算的配比和适当提高充电限制电压，可大幅提高二次锂离子电池的比能量和平均工作电压而不影响电池循环性能。本发明还提供采用该方法的二次锂离子电池或电池组，适用于该二次锂离子电池或电池组的保护电路，采用所述保护电路的使用二次锂离子电池或电池组的电子装置以及用于二次锂离子电池或电池组的充电装置。

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二次锂离子电池或电池组、其保护电路、电子装置和充电装置

技术领域

本发明涉及提高二次锂离子电池或电池组的容量、平均工作电压和比能量的方法，同时也涉及采用该方法制备的二次锂离子电池或电池组、用于所述二次锂离子电池或电池组的保护电路、使用所述二次锂离子电池或电池组的电子装置和用于二次锂离子电池或电池组的充电装置。

背景技术

自 1990 年，日本 Sony 公司发明研制出二次锂离子电池并商品化以来，锂离子电池产业得到迅猛发展，至 2000 年，全球各大锂离子电池制造商为了提升产品的竞争力，针对提高锂离子电池容量这一技术核心展开了全面竞争。目前已商品化的二次锂离子电池容量的提升主要是依靠增加活性物质（正负极材料）的填充量来予以实现，然而锂离子电池体积的有限性使电池的容量的提升受到了极大地限制。开发比能量更高的活性物质（正负极材料），大幅提升电池容量的科研工作已在全球范围内展开，但到目前为止，在技术上还没有大的突破，并存在许多技术上的障碍。

其实，目前的二次锂离子电池的正负极材料已经具有相当高的理论克容量，只是实际利用的效能太低。如：作为二次锂离子电池正极材料的钴酸锂，其理论克容量高达 248mAh/g，而实际使用的克容量才达 120mAh/g 左右，也就是说还有一半的潜能没有发挥出来，其原因之一是目前使用的充电限制电压较低。目前二次锂离子电池制造业中公认的行业技术要求是将单体二次锂离子电池充电限制电压

限于不超过 4.2V，并且，现今在世界各国上市的锂离子电池均是在这一技术要求下生产制造出来的。如：单体锂离子电池在化成工艺处理过程中，充电限制电压为 4.2 伏以下，其保护电路的过充保护释放电压控制在 4.15 伏以下。将充电限制电压控制在 4.2 伏的原因，是以往的研究成果和大量的文献报道认为：提高充电限制电压，虽然可以提高锂离子电池的容量和平均工作电压，但当充电限制电压大于 4.2 伏时，锂离子电池的正负极材料结构会发生变化，电解液也会发生分解，从而影响电池的循环性能。

例如，对于目前商业化的锂离子电池大多用作正极材料的钴酸锂而言，虽然许多文献显示以锂金属作为对电极制成实验电池时的充电限制电位可以在 4.2V 以上，但在以钴酸锂为正极的商品化锂离子电池中，充电限制电压都在 4.2V 以下，从而使钴酸锂的实际克容量为 120-130 毫安时/克，即仅仅是理论容量的 50%左右。实际上，根据 MIZUSHIMAK 等人的报道"具有高能量密度的新型阴极材料"(A new cathode material for batteries of high energy density. MaterResBull. 1980, 15:783)：锂离子的脱出量随充电电压的升高而升高，钴酸锂的电化学克容量也会随之升高。但是，研究认为以金属锂作为对电极钴酸锂的可逆充放电位在 4.3V 左右，超过 4.3V 钴酸锂的结构会发生变化，晶格参数 C 会由 4.4 纳米降至 4.0 纳米，钴酸锂的结构因之发生变化，影响电池的循环寿命。

G. PISTOIA 等人(J Power Source, 56(1995), 37-43.)认为钴酸锂的结构会随着充电电压的变化而变化，超过一定电压会出现单斜相与六方相共存的情况。此时会影响电池的循环性能，造成电池循环性能的下降。实验发现，在以锂金属作为负极的扣式实验电池中，当充电限制电压提高至 4.35V 时，钴酸锂的克容量可以达到 159 毫安时/克。但循环几周后，就下降至 135 毫安时/克。充电限制电压

为 4.25V 时，容量衰减也很快。文献认为只有当充电限制电压在 4.15V 时，钴酸锂保持良好的循环性能，克容量保持在 130 毫安时/克左右。但是单斜相对应的电位是 4.05V，六方相所对应的电位是 4.17V，都在 4.2V 以内。

还有文献（雷永泉主编《新能源材料》，2000P136）给出了用 EC/DMC 的作为混合溶剂，用 LiPF6 作为电解质的电解液在铝箔集流体上的分解电位是 4.2V。由此认为充电限制电压超过 4.2V 以上时会分解电解液，影响电池的循环寿命。

1990 年 SONY 公司推出以焦碳作为负极的锂离子电池，充电限制电压为 4.20V 以下，此成为以后锂离子电池公认的技术要求。

这是因为，现有技术认为：

1. 充电限制电压的提高会使正极物质的结构发生改变，结构的改变又集中在两个方面，其中一方面结构的变化主要是相的变化即六方相和单斜相的转变与共存，会严重影响锂离子电池的循环寿命。另一方面是晶格参数的变化会使锂离子进出的通道变窄，从而使锂离子所占的空隙受到挤压，进而堵塞锂离子的通道，降低锂离子电池的循环性能。

2. 提高充电限制电压会使电解液在高电位下发生分解，电解液的减少又会使锂离子的传输变得困难，从而严重影响电池的循环寿命。

从中可以看出，对于锂离子二次电池，由于充电电压的限制，限制了电极活性材料实际的有效利用率，在此条件下即使今后开发出了比能量更高的正负极材料，锂离子电池也无法发挥出最佳的效能。因此，迫切需要一种提升锂离子电池活性物质的效能利用率，进而提高电池容量和平均工作电压，同时保持较好的电池性能的方法。

发明内容

针对本领域中普遍认为将充电限制电压提高到高于4.2伏以后会大幅度降低电池的循环寿命这一观点，本发明人围绕提高充电限制电压，提升电池容量做了大量相关实验和研究。与上述观点相反，本发明人出人意料地发现，通过提高充电限制电压，并适当调整单体锂离子电池的正、负极的配比，可以大大提高二次锂离子电池中电极活性材料的利用率，从而提高二次锂离子电池或电池组的比能量、容量和平均工作电压，而基本不改变电池的性能。本发明正是基于上述发现而得以完成的。

本发明的一个目的是提供提高二次锂离子电池或电池组的比能量和平均工作电压的新方法，其中该单体电池的充电限制电压大于4.2V，但不超过5.8V，单体锂离子电池的正、负极的配比按充电限制电压为4.2V的理论克容量计算在1：1.0～1:2.5，优选在1：1.15—1：2.5。

本发明另一个目的是二次锂离子电池或电池组，该单体二次锂离子电池的充电限制电压大于4.2V，但不超过5.8V，其单体锂离子电池的正、负极的配比按充电限制电压为4.2V的理论克容量计算为1:1.0～1:2.5，优选该配比在1：1.15～1:2.5。

本发明又一个目的是用于上述二次锂离子电池或电池组的保护电路，该保护电路的首次过充保护电压大于4.35V，过充保护释放电压大于4.15V。

本发明再又一个目的是以二次锂离子电池或电池组为能源的电子装置，该电子装置包括使单体锂离子电池的首次过充保护电压大于4.35V、过充保护释放电压大于4.15V的保护电路。

本发明再又一个目的是提供用于二次锂离子电池或电池组的充电装置，该充电装置对单体锂离子电池的充电限制电压控制在大于

4.3 V、但不超过 5.8V,该充电限制电压优选控制在 4.3V-5.2V，更优选在 4.3V-4.8V。

实施本发明具体方式

与本领域中普遍认为应该将充电限制电压限于 4.2 伏相反，本发明人通过逐步提高充电限制电压，并适当调整单体锂离子电池的正、负极的配比，在考察提高充电限制电压后的电池性能的大量实验中，出乎意料地发现，能够在基本不改变其它电池特性的同时，可以低成本地显著提高二次锂离子电池或电池组的容量、比能量和平均工作电压。在本发明中，"锂离子电池或电池组"是指本发明既可应用于锂离子单体电池，也可应用于包括保护电路的单体锂离子电池，也可应用于包括多个单体锂离子电池的电池组，也可应用于包括多个单体锂离子电池及保护电路的电池组，为了简便起见，有时也统称为"锂离子电池"。此外，本发明中"正、负极材料的理论克容量"是指正、负极材料按照充电限制电压为 4.2V 时的理论克容量。

本发明人通过逐步提高充电限制电压，研究了充电限制电压与二次锂离子电池的电池特性的关系。例如，在试验中，在对市售二次单体锂离子电池进行检测及自制二次单体锂离子电池化成检测时，本发明人将充电限制电压的工艺参数由 4.2 伏,提高至 4.30 伏、4.35 伏、4.40 伏、4.45 伏和 4.6 伏。结果发现，在充电限制电压为 4.3 伏、4.35 伏、4.40 伏时，其比能量比充电限制电压为 4.2 伏时提高了约 6-20%，电池仍然可以保护良好的循环性能，循环 50 次，容量保持在 95%以上，循环 500 次，容量保持在 80%以上，和充电限制电压在 4.2 伏时的循环性能相当。然而在充电限制电压提高至 4.45 伏以上时，比能量虽然提高了近 30%，但循环性能较差，循环 6 次后，容量保持率仅为 83.9%。

为了找出充电限制电压提高至 4.45 伏以上时循环性能较差的原因，本发明人在做了大量基础研究和理论探索后，调整了正负极材料容量配比，即：将锂离子电池的正负极材料按充电限制电压为 4.2V 时的理论克容量计算的配比调整为 1：1.3～2.5。之后将正、负极材料容量配比调整后的单体锂离子电池，分别在充电限制电压为 4.45 伏、4.6 伏，4.8 伏、5.0 伏、5.2 伏、5.4 伏、5.6 伏、5.8 伏时进行充电试验，优选在化成、检测时进行该充电试验。其实验结果显示，在适当的正负极材料配比下，充电限制电压为 4.45 伏以上时，电池的比能量可以大幅提高，而电池的循环性能基本不会受到影响。

本发明方法中对提高充电电压的操作优选在电池化成、检测时进行。因为将电池的充电限制电压提高至 4.20V 以上，既提高了电池的比能量，提高了正极活性物质的克容量，提高了电池的平均工作电压，又对电池进行了活化，使其可以达到最佳使用状态。既起到原有的化成工艺所应具有的效果，又可以极大提高锂离子电池的比能量从而起到一举两得的效果。达到了既不改变原有工艺流程，又提高了目前商品化锂离子电池的比能量，增强锂离子电池竞争力的目的。

形成以上实验结果的机理还需进一步研究，不希望为任何理论所限制，在此推测可能的原因有：

1.充电限制电压提高后，使锂离子从正极材料中脱出的比例大幅度提高，造成了与原来负极材料容量的不匹配，使过多的锂离子在负极表面沉积成金属锂，从而堵塞住锂离子进出的一部分通道，造成容量衰减，影响循环性能。增大负极材料容量，满足了相对过多的锂离子嵌入的需要，因此避免了锂离子在负极表面沉淀成金属锂，使电池的荷电保持性能和循环性能没有受到影响。选择合适的正负

极配比可以避免金属锂沉积在负极表面，从而避免堵塞了锂离子进出的通道被堵塞，从而避免锂离子电池容量的衰减。尤其当锂离子电池充电限制电压大于 4.45V 时，原有的锂离子电池的负极更加呈现出不足状态，过多的锂离子会在负极表面沉积成金属锂，从而堵塞住锂离子进出的一部分通道，造成容量的衰减。较大幅度提高负极的含量，可望减少锂离子电池容量因循环次数的增多而造成的衰减。依照此思路，我们作了系列实验，实验结果证明了我们的推测（见实施例）。

2. 充电限制电压控制在一定范围内，极少量的电解液分解对电池的循环性能影响极小。使用高分解电位的电解质会有更好的表现，或加入可以提高电解液分解电位的添加剂。电解液的分解主要是发生在正极上，虽然文献认为，以 $LiPF_6$ 为电解质，以 EC/DMC 混合液作为溶剂的电解液在铝箔表面的分解电压为 4.2V，但是从实验结果来看，这一因素对目前已商品化的锂离子电池的循环寿命基本没有影响。可以认为即使电解液在高于 4.2V 的电压发生了分解，由于电能主要用来转化成化学能，所以能用与分解电解液的电能是微不足道，而这一部分电解液的分解对锂离子电池的循环寿命几乎没有影响。至于在分解电位以上的电压范围如 5.0V 以上，也可以加入物质 A 或采用具有更高分解电位的电解液体系 B. 表 1 列出了目前所用的电解液组分的分解电位，从中可以看出溶剂的最低分解电压也在 4.5V 以上。

表 1 各种混合电解液的分解电位

溶质	$LiCLO_4$	$LiAsF_6$	$LiPF_6$
混合溶剂	分解电位(V)	分解电位(V)	分解电位(V)
PC:DME	4.51	4.72	
PC:DEC	4.5	4.5	
PC:EC		4.5	
PC:EC:DME	4.5	4.62	
PC:DEC:2MLF		4.52	
EC:DEC		4.9	4.8
EC:DMC			4.9
B			5.9

3.充电限制电压提高至 4.2V 以上，锂离子电池之所以未出现文献所述的由于结构变化造成的容量衰减，可能是因为：由于第一次锂离子脱出以后，有约 10%左右的锂离子用以形成钝化膜，从而使锂离子的实际空隙多于锂离子所应占的空隙，锂离子所拥有的空隙大于处于活化状态锂离子所需占用空隙的 10%左右，虽然电压的提高会改变正极材料的结构，使晶格变小，但是由于实际脱出和嵌入的锂离子所占的空隙少于正极活性物质所实际具有的空隙，所以一定范围的结构变化不会使锂离子在脱出和嵌入的过程中受阻，也就不会影响电池的循环寿命。使用结构随电位变化更稳定的正、负极材料会有更好的表现。虽然正极过充电会产生不导电的惰性物质。但从实验结果来看，只有当锂离子完全脱出来时才有可能，例如对于钴酸锂，镍酸锂及掺杂的钴酸锂，镍酸锂而言，用 3C5A 的电流充电时，实验数据显示只有当电池电压在 6.20V 左右时锂离子才会完全脱出，大量释放氧气，形成绝缘体，而对于锰酸锂及掺杂的锰酸锂，采用同样的充电电流，锂离子完全脱出时电池电位一般为 6.50V 左右。

一般情况下由于目前商业化锂离子电池所用的正极活性物质的实际比能量远远低于理论比能量，即使充电限制电压提高至5.8V，在选用适当的配方的前提下，也没有达到其理论容量，因而不存在过充电的问题。所以本发明的方法仍然具有很大的安全性。

4.除以上因素外，电池的自放电大小，集流体选用，钝化膜形成都会影响锂离子电池的循环寿命，而这些因素主要取决于锂离子电池的制造工艺。可以肯定，在选择了较优的制作工艺之后，采用本发明的方法可以大幅度地提高锂离子电池的容量、平均工作电压、比能量，而不会影响锂离子电池的循环寿命以及其他性能。

因此，本发明提供了一种新颖的有效提高二次锂离子电池或电池组的比能量和平均工作电压的方法，在该方法中，与现有技术相反，当通过将单体锂离子电池的充电限制电压提高到大于4.2V但不超过5.8V，并且单体锂离子电池的正、负极的配比按理论克容量计算在1:1.0～1:2.5时，可以提高电极活性材料的利用效率，从而提高电池的容量、能量密度和输出电压，同时又不损害电池的使用性能。为了取得较好的效果，本发明还优选该充电限制电压在4.3V～5.2V，更优选在4.3V～4.8V。此外，本发明优选将单体锂离子电池的正、负极的配比按充电限制电压为4.2V时的理论克容量计算限制在1:1.15～1:2.5的范围。试验表明，当采用的工艺参数超出上述配比范围时，电池性能变差，不适合使用。当负极与正极的配比按理论克容量计算小于1.0时，电池循环寿命过分降低，当负极与正极的配比按理论克容量计算大于2.5时，电池的体积效率显著降低。另外，当提高充电限制电压超过5.8V以后，电池特性变差，不适合使用。

从中可以看出，通过适当调整正、负极材料按照理论克容量计算的配比和适当提高充电限制电压，可以在不影响电池循环性能的前

提下，大幅度提高二次锂离子电池的容量、比能量和平均工作电压，使锂离子电池更具商业价值和更广的应用范围。因此，可以认为本发明方法还优化了正负极活性材料的利用率，从而它也是一种经济的方法。本发明人有理由相信，今后即使开发出了具有更高比能量的正负极材料，本技术仍然可以使其提高效能利用率，达到最佳的使用效果。

此外，值得指出的是，采用本发明的方法，并不会使电池工作于极端的工作状态。经过反复试验，本发明人从未发现本发明方法会造成电池损毁的概率增加。因此，本发明方法还是一种安全的方法。

此外，本发明还提供比能量和平均工作电压得到提高的新颖的二次锂离子电池或电池组，在该二次锂离子电池或电池组中，与现有技术相反，所述单体锂离子电池的充电限制电压大于 4.2V 但不超过 5.8V，并且单体锂离子电池的正、负极的配比按充电限制电压为 4.2V 时理论克容量计算在 1: 1.0～1:2.5，与现有技术二次锂离子电池或电池组相比，该二次锂离子电池或电池组的容量、能量密度和输出电压得到大幅度提高，同时还既有与现有技术电池相当的循环寿命。为了取得较好的效果，本发明还优选所述充电限制电压在 4.3V～5.2V，更优选在 4.3V～4.8V。此外，优选将所述单体锂离子电池的正、负极的配比按充电限制电压为 4.2V 时的理论克容量计算限制在 1: 1.15～1:2.5 的范围。试验表明，当该二次锂离子电池或电池组的电池参数超出上述配比范围时，电池性能变差，不适合使用。当负极与正极的配比按理论克容量计算小于 1.0 时，电池循环寿命过分降低，当负极与正极的配比按理论克容量计算大于 2.5 时，电池的体积效率显著降低。另外，当提高充电限制电压超过 5.8V 以后，电池特性变差，不适合使用。

另外，重要的是，本发明的方法不仅适用于本发明的二次锂离子

电池或电池组，而且，还可应用于按现有技术方法得到的二次锂离子电池或电池组，例如目前商品化的二次锂离子电池或电池组。

以下以非限制方式更具体地介绍适用于本发明方法的二次锂离子电池。二次锂离子电池的一般结构包括：正极、负极、非水电解质和将正极与负极相互隔开的隔膜组成。非水电解质通过将含锂的金属盐例如 $LiPF_6$ 作为电解质溶解在例如碳酸亚乙酯或碳酸二甲酯的非水溶剂中而得到。隔膜在上述非水溶剂中不溶解，并且是由例如聚乙烯或聚丙烯树脂制成的多孔膜。其中，本发明中单体锂离子电池正负极活性物质比例按照充电限制电压为4.2V时的正负极活性物质的理论克容量来计算。

正极

正极制备可例如采用通过将正极活性材料、导电剂和粘合剂在适当溶剂中悬浮而制成的悬浮液涂覆集流器例如铝箔上，接着干燥并压制涂覆过悬浮液的集流器而获得。

本发明中电池正极活性物质为含锂元素的化合物。虽然在实施例中本发明使用了钴酸锂（即锂钴复合氧化物）、锰酸锂和镍酸锂作为正极活性材料进行了描述，但是应该理解，本发明的实施并不依赖于所述含锂复合氧化物的特性，而可以广泛地适用于各种正极活性材料。他们的共同特点也是比能量随着电位的升高而提高，通过实验证明（见实施例），充电限制电压提高至4.20V以上时，电池的容量可以大幅度提高，不影响电池的其他性能。同样本发明也适用于以各种掺杂型的含锂元素作为正极活性物质的锂离子电池，如包括各种氧化物和硫化物的正极活性材料，其实例包括例如，锂钴复合氧化物、锂锰复合氧化物、锂镍复合氧化物、锂镍钴复合氧化物、锂锰钴复合氧化物、和钒氧化物。在这些正极活性材料中，优选使用具有高电池电压的锂钴复合氧化物（例如 $LiCoO_2$）、锂锰复合氧化

物（例如 $LiMn_2O_4$）、锂镍复合氧化物（例如 $LiNiO_2$）、锂镍钴复合氧化物（例如 $LiNi_{1-x}Co_xO_2$）、锂锰钴复合氧化物（例如 $LiMn_xCo_{1-x}O_2$）。

此外，本发明可使用公知的导电剂和粘合剂。正极活性材料中各组分的混合比例可使用公知的比例范围。

隔膜

本发明所用的隔膜是公知的隔膜，例如可以是由合成树脂的无纺布、聚乙烯多孔膜或聚丙烯多孔膜以及由此类材料复合而成的材料制成的类型。

负极

负极制备可例如采用通过将负极活性材料、导电剂和粘合剂在适当溶剂中悬浮而制成的悬浮液涂覆集流器例如铜箔、镍箔或不锈钢箔上，接着干燥并压制涂覆过悬浮液的集流器而获得。

本发明中电池负极活性物质为锂离子能在其中嵌入和脱出的碳系和非碳系的物质，包括，例如，锂合金（例如，$Li_4Ti_5O_{12}$）、金属氧化物（例如非晶态锡氧化物、WO_2 和 MoO_2）、TiS_2 以及能吸收和去吸收锂离子的碳系物。特别希望使用碳系物充当负极活性材料。

本发明所用的碳系物包括，例如，石墨、无取向性石墨、焦炭、碳纤维、球形碳、树脂烧结碳和汽相生长碳，纳米碳管。因为包含如上所述的特定碳纤维或球形碳的负极表现出高充电效率，特别希望使用中间相沥青基碳纤维或中间相沥青基球形碳充当碳素物。中间相沥青基碳纤维和中间相沥青基球形碳可采用公知的方法获得。

非水电解质和外壳均可采用公知的类型和材料，并未特别限定，非水电解质，例如可以使用，在非水溶剂中溶解电解质而制成的液体非水电解质、将聚合物、非水溶剂和溶解物复合而制成的胶体非水电解质、聚合物固体非水电解质等等。

作为电池的结构可以是通过隔膜将阴极和阳极缠绕而形成螺旋状或

通过隔膜使阴极和阳极层叠而形成层状结构，但是电池的结构并不限于特定的形状，可以制成例如柱状、棱形状、硬币状、钮扣式等形状。

对电池的充放电操作除电压采用本发明工艺参数外，均采用本领域公知的方式进行。

由于本发明使用的电压参数高于本领域目前采用的电压参数，因此需要对应用了本发明方法或用于本发明的二次锂离子电池的保护电路和包括该电路的相关设备、装置进行改进。在此，不特别限定本发明用于上述二次锂离子电池或电池组的保护电路，可采用公知的结构类型，只要其首次过充保护电压大于 4.35V，过充保护释放电压大于 4.15V 即可。并且还优选首次过充保护电压大于 4.45V，过充保护释放电压大于 4.25V。

此外，不特别限定本发明的以二次锂离子电池或电池组为能源的电子装置，可采用公知的结构类型，只要其中该电子装置具有使单体锂离子电池的首次过充保护电压大于 4.35V、过充保护释放电压大于 4.15V 的保护电路即可；优选的首次过充保护电压大于 4.45V，过充保护释放电压大于 4.25V。本发明提供的电子装置包括，例如，笔记本型电子计算机、便携电话和掌上电脑（PDA），电动自行车，电动车等。

类似地，本发明用于二次锂离子电池或电池组的充电装置可以是满足以下条件的任何类型和结构的充电装置，即该充电装置将单体锂离子电池的充电限制电压控制在大于 4.3 V、但不超过 5.8V，优选控制在 4.3V－5.2V，更优选在 4.3V－4.8V。

实施例

下面将根据具体的试验结果详细叙述本发明。

单体锂离子电池的制备

本发明一个实施例中，使用的单体锂离子电池制作过程如下：

采用铜箔作为负极的集流体，铝箔作为正极的集流体，正极活性物质用钴酸锂，负极活性物质用 MCMB。电池型号为方型 653466。将钴酸锂与 7%的黏合剂 PVDF 和 5%的导电碳黑混合，按 1：1 的比例加入 NMP 溶剂中。负极物质可以直接与 10%的黏合剂 PVDF 进行混合，按 1：1 的比例加入，制成浆料。将和好的正极浆料用涂敷的方法涂在正极的集流体上，负极浆料涂敷在负极集流体上，然后烘干，经过压制后，再进行涂敷处理。正极用涂敷浆料是将碳系材料和 PVDF 的混合后溶于有机溶剂制成。在烘干后的正极极片上，进行涂敷，涂敷后进行压制，然后烘干。

将烘干后的正负极片点上极耳，插入隔膜后，在卷绕机上卷绕后装入电池壳中，电池壳材料可以为铝材或钢材。隔膜为 PP 材料。将电池壳和电池盖用激光焊接的方法焊接在一起。在相对湿度小于 1.5%的环境下进行注液，电解液采用 EC：DEC：DMC=1：1：1 的混合溶剂，电解质为 1M 六氟磷酸锂，注液后立即封口。

实施例 1

按上述方法制成 653466 方型的多个锂离子电池，正负极配比分别为 1：1.0、1：1.05、1：1.1、1：1.15、1：1.2、1：1.25、1：1.3，用 4.20V 作为充电限制电压进行化成、检测，上述电池的算术平均结果显示电池容量为 1113 毫安时，重量比能量为 102 瓦时/千克，平均工作电压为 3.70V，循环 400 次容量保持 85.72%。

实施例 2

按上述方法制成 653466 方型的多个锂离子电池，正负极配比分别为 1：1.0、1：1.05、1：1.1、1：1.15、1：1.2、1：1.25、1：1.3，用 4.30V 作为充电限制电压进行化成检测，上述电池的算术平均结果显示电池容量为 1206 毫安时，重量比能量为 113 瓦时/千克，

平均工作电压为 3.75V，循环 400 次容量保持 86.31%。

实施例 3

按上述方法制成 653466 方型的多个锂离子电池，正负极配比分别为 1：1.0、1：1.05、1：1.1、1：1.15、1：1.2、1：1.25、1：1.3，用 4.35V 作为充电限制电压进行化成检测，上述电池的算术平均结果显示电池容量为 1253 毫安时，重量比能量为 119 瓦时/千克，平均工作电压为 3.8V，循环 400 次容量保持 84.79%。

实施例 4

按上述方法制成 653466 方型的多个锂离子电池，正负极配比分别为 1：1.0、1：1.05、1：1.1、1：1.15、1：1.2、1：1.25、1：1.3，用 4.40V 作为充电限制电压进行化成检测，上述电池的平均结果显示电池容量为 1302 毫安时，重量比能量为 123 瓦时/千克，平均工作电压为 3.80V，循环 400 次容量保持 83.93%。

实施例 5

按上述方法制成 653466 方型锂离子电池，正负极配比为 1:1.45，用 4.45V 作为充电限制电压进行化成检测，结果显示电池容量为 1365 毫安时，重量比能量为 129 瓦时/千克，平均工作电压为 3.85V，循环 400 次容量保持 84.56%。

实施例 6

按上述方法制成 653466 方型锂离子电池，调整正负极比例为 1:1.6，用 4.60V 作为充电限制电压进行化成检测，结果显示电池容量为 1692 毫安时，重量比能量为 165 瓦时/千克，平均工作电压为 3.9V，循环 400 次容量保持 85.13%。

实施例 7

按上述方法制成 653466 方型锂离子电池，调整正负极比例为 1:1.7，用 4.80V 作为充电限制电压进行化成检测，结果显示电池容量

为1824毫安时，重量比能量为178瓦时/千克，平均工作电压为3.9V，循环400次容量保持83.92%。

实施例8

按上述方法制成653466方型锂离子电池，调整正负极比例为1:1.9，加入能提高分解电位的A物质或选择具有较高分解电位的电解液B，用5.00V作为充电限制电压进行化成检测，结果显示电池容量为1894毫安时，重量比能量为186瓦时/千克，平均工作电压为3.93V，循环400次容量保持81.23%。

实施例9

按上述方法制成653466方型锂离子电池，在正极浆料中加入15%另一种含锂元素的化合物C，调整正负极比例为1:2.2，用5.20V作为充电限制电压进行化成检测，结果显示电池容量为1962毫安时，重量比能量为194瓦时/千克，平均工作电压为3.96V，循环400次容量保持81.19%。

实施例10

按上述方法制成653466方型锂离子电池，在正极浆料中加入15%另一种含锂元素的化合物C，调整正负极比例为1:2.3，用5.40V作为充电限制电压进行化成检测，结果显示电池容量为1968毫安时，重量比能量为195瓦时/千克，平均工作电压为3.96V，循环400次容量保持81.19%。

实施例11

按上述方法制成653466方型锂离子电池，在正极浆料中加入15%另一种含锂元素的化合物C，调整正负极比例为1:2.4，用5.60V作为充电限制电压进行化成检测，结果显示电池容量为1970毫安时，重量比能量为195瓦时/千克，平均工作电压为3.96V，循环400次容量保持79.97%。

实施例 12

按上述方法制成 653466 方型锂离子电池，在正极浆料中加入 15% 另一种含锂元素的化合物 C，调整正负极比例为 1：2.5，用 5.80V 作为充电限制电压进行化成检测，结果显示电池容量为 1972 毫安时，重量比能量为 195 瓦时/千克，平均工作电压为 3.96V，循环 400 次容量保持 78.82%。

实施例 13

按上述方法制成 653466 方型锂离子电池，在正极浆料中加入 15% 另一种含锂元素的化合物 C，调整正负极比例为 1：2.6，用 5.90V 作为充电限制电压进行化成检测，结果显示电池容量为 1565 毫安时，循环 15 次容量保持 12.31%。

从以上实施例可见，将充电电压提高到 4.2V 以上后，随着该电压提高，可提高电池容量和工作电压，重量比能量也提高了；当充电电压提高到 4.45V 以上后，随着该电压和正负极配比值的提高，可继续提高电池容量和工作电压和重量比能量；但是，该电压超过 5.8V 后，电池特性下降。

实施例 14－18

以锰酸锂为正极活性材料，按照与上述锂离子电池相同的制作方法，制备锂离子电池。其中正极浆料由 4 克的锰酸锂，0.6 克碳黑，0.32 克 PVDF，4.92 克 NMP 组成，负极浆料由 2.6 克 MCMB，0.26 克 PVDF，3.0 克 NMP 组成。电池型号为 063048 型方形锂离子电池具体实验数据见下表 2

表 2

实施例	充电限制电压（V）	工艺调整	循环性能	容量（毫安时）
14	4.20	无	400 次容量保持 84.23%	375
15	4.30	无	400 次容量保持 85.12%	405
16	4.60	正负极比例为 1: 1.6	400 次容量保持 83.45%	575
17	5.80	正负极比例为 1: 2.5，电解液中加入 A 物质.	400 次容量保持 82.83%	567
18	5.90	正负极比例为 1: 2.7，电解液中加入 A 物质.	30 次容量保持 54.23%	312

实施例 14－18 显示采用锰酸锂基的正极活性材料仍取得与实施例 1－13 相似的结果。将充电电压提高到 4.2V 以上后，随着该电压提高，可提高电池容量和工作电压，重量比能量也提高了；当充电电压提高到 4.45V 以上后，随着该电压和正负极配比值的提高，可继续提高电池容量和工作电压和重量比能量；但是，该电压超过 5.8V 后，电池特性下降。

实施例 19－23

以镍酸锂作为正极活性材料，按照与上述以钴酸锂为正极活性材料的锂离子电池的制作方法相同的方法，制备锂离子二次电池，正极浆料由 4 克的镍酸锂，加入 0.2 克碳黑，0.2 克 PVDF，4.80 克 NMP 组成，负极浆料由 3.5 克 MCMB，0.35 克 PVDF，4.0 克 NMP 组成。电池型号为 063048 型方形锂离子电池具体实验数据见下表 3.

表 3

实施例	充电限制电压（V）	工艺调整	循环性能	容量（毫安时）
19	4.20		400 次容量保持 81.23%	610
20	4.30		400 次容量保持 80.72%	675
21	4.60	正负极比例为 1: 1.6	400 次容量保持 78.32%	912
22	5.80	正负极比例为 1: 2.5 电解液中加入 A 物质。	400 次容量保持 75.83%	879
23	5.90	正负极比例为 1: 2.7 电解液中加入 A 物质。	50 次容量保持 47.53%	796

实施例 19－23 显示了采用镍酸锂基的正极活性材料仍取得与实施例 1－16 相似的结果。将充电电压提高到 4.2V 以上后，随着该电压提高，可提高电池容量和工作电压，重量比能量也提高了；当充电电压提高到 4.45V 以上后，随着该电压和正负极配比值的提高，可继续提高电池容量和工作电压和重量比能量；但是，该电压超过 5.8V 后，电池特性下降。

实施例 24－28

以掺钴的镍酸锂作为正极活性材料，按照与以钴酸锂为正极活性材料的锂离子二次电池相同的制作方法，制备锂离子二次电池。正极浆料由 4 克的镍酸锂，加入 0.2 克碳黑，0.2 克 PVDF，4.80 克 NMP 组成，负极浆料由 3.5 克 MCMB，0.35 克 PVDF，4.0 克 NMP 组成。电池型号为 063048 型方形锂离子电池具体实验数据见下表 4。

表 4

实施例	电限制电压（V)	工艺调整	循环性能	容量（毫安时）
24	4.20		400 次容量保持 81.23%	623
25	4.30		400 次容量保持 80.72%	682
26	4.60	正负极比例为 1: 1.6	400 次容量保持 78.32%	934
27	5.80	正负极比例为 1: 2.5 电解液中加入 A 物质.	400 次容量保持 75.83%	919
28	5.90	正负极比例为 1: 2.7 电解液中加入 A 物质.	50 次容量保持 39.53%	697

实施例 24－28 显示了采用掺杂含锂复合氧化物的正极活性材料仍取得与实施例 1－21 相似的结果。将充电电压提高到 4.2V 以上后，随着该电压提高，可提高电池容量和工作电压，重量比能量也提高了；当充电电压提高到 4.45V 以上后，随着该电压和正负极配比值的提高，可继续提高电池容量和工作电压和重量比能量；但是，该电压超过 5.8V 后，电池特性下降。这同时还说明本发明的方法不限于某种特定的含锂复合氧化物的正极活性材料，而可广泛地用于各种锂离子二次电池。

应用本发明方法，可以在锂离子电池生产工艺中及相关的产品改进中得到以下应用:

1. 单体锂离子电池在正负极材料按理论克容量计算获得最佳的

容量匹配调整后，在化成检测时，将充电限制电压调整至大于 4.2V 但不超过 5.8 伏，可以获得循环性能很好的高容量二次锂离子电池，其优势在于：既起到原有化成工艺所应具有的效果，又可大幅提高锂离子电池的比能量和平均工作电压，而成本并未增加。对于锂离子电池制造商而言，可以大幅提高利润率和企业竞争力；对于锂离子电池应用配套的产品而言，容量和平均工作电压的提高，可以使配套产品的性能也加以提升。

2. 建立在本发明技术基础上的单体二次锂离子电池的保护电路，其过充保护释放电压大于 4.15 伏，首次过充保护电压大于 4.35 伏。

3. 应用本发明技术制备的单体锂离子电池可以和上述具有本技术特征的保护电路组合生产出二次锂离子电池或电池组。

4. 具有本发明技术特征的保护电路可以应用于以二次锂离子电池或电池组为能源的移动电子装置和产品。

本发明技术对提高二次锂离子电池容量、平均工作电压及比能量，具有非常重大的商业价值，对丰富锂离子电池的基础理论研究有一定的贡献。相信本技术的推动力将贯穿二次锂离子电池产业的整体发展。

权 利 要 求

1. 提高二次锂离子电池或电池组的容量、平均工作电压和比能量的方法，其特征在于对该单体锂离子电池的充电限制电压大于4.2V，但不超过5.8V，优选该充电限制电压在4.3V～5.2V，更优选在4.3V～4.8V；单体锂离子电池的正、负极的配比按充电限制电压为4.2V时的理论克容量计算在1：1.0～1:2.5，优选该配比在1:1.15～1:2.5。

2. 二次锂离子电池或电池组，其特征在于该单体锂离子电池的充电限制电压大于4.2V，但不超过5.8V，优选该充电限制电压在4.3V～5.2V，更优选在4.3V～4.8V；其单体锂离子电池的正、负极的配比按理论克容量计算在1:1.0～1:2.5,优选该配比在1:1.15～1:2.5。

3. 如权利要求2所述的二次锂离子电池或电池组，其特征在于单体锂离子电池首次过充保护电压大于4.35V,过充保护释放电压大于4.15V，优选在其首次过充保护电压大于4.45V，过充保护释放电压大于4.25V。

4. 用于权利要求2或3的二次锂离子电池或电池组的保护电路，其特征在于其单体锂离子电池首次过充保护电压大于4.35V,过充保护释放电压大于4.15V，优选在其首次过充保护电压大于4.45V，过充保护释放电压大于4.25V。

5. 以二次锂离子电池或电池组为能源的电子装置，其特征在于该电子装置具有使单体锂离子电池的首次过充保护电压大于4.35V、过充保护释放电压大于4.15V的保护电路，优选在其首次过充保护电压大于4.45V，过充保护释放电压大于4.25V。

6. 用于二次锂离子电池或电池组的充电装置，其特征在于该充

电装置对单体锂离子电池的充电限制电压控制在大于4.3 V、但不超过 5.8V，该充电限制电压优选控制在 4.3V-5.2V，更优选在4.3V-4.8V。

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN02/00696

A. CLASSIFICATION OF SUBJECT MATTER

IPC[7] H01M 10/44 H02J 7/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC[7] H01M 10/44 10/46 10/42 H02J 7/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

CNPAT

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI PAJ EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN1135103A, 6 November 1996(06.11.96), claims 1-26.	1-6
A	CN1185860A, 24 June 1998(24.06.98), the whole document.	1-6
A	US5604418A, 18 February 1997(18.02.97), column 3,line 26 - column 4, line 24, Claims1-4.	1-6
A	JP2000-270491A, 29 September 2000(29.09.00), the whole document.	1-6

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
23 December 2002 (23.12.02)	02 [illegible] (02.01.03)
Name and mailing address of the ISA/CN 6 Xitucheng Rd., Jimen Bridge, Haidian District, 100088 Beijing, China Facsimile No. 86-10-62019451	Authorized officer YAN, Hong Telephone No. 86-10-6209[illegible]800

Form PCT/ISA /210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN02/00696

Patent document cited in search report	Publiction Date	Patent family member(s)	Publiction Date
CN1135103A	06.11.96	JP3239040B2	17.12.01
		JP8289478 A	01.11.96
		US5654622A	05.08.97
CN1185860A	24.06.98	CA2218709A	28.08.97
		WO9731401A	28.08.97
		US5721067A	24.02.98
		EP0845158AB	03.06.98
		EP19970902122	12.02.97
		JP10512712T	02.12.98
		JP3206604B2	10.09.01
		BR9702193	28.12.99
		DE69707622D	29.11.01
US5604418A	18.02.97	DE69602777E	15.07.99
		EP0729212A1	28.08.96
		FR2731112A1	30.08.96
		FI9600879A	28.08.96
		CA2170315A	28.08.96
		JP8287957A	01.11.96
		CN1137183A	04.12.96
		EP0729212B1	09.06.99
JP2000-270491A	29.09.00	NONE	

国际检索报告

国际申请号 PCT/CN02/00696

A. 主题的分类

IPC[7] H01M 10/44 H02J 7/00

按照国际专利分类表(IPC)或者同时按照国家分类和 IPC 两种分类

B. 检索领域

检索的最低限度文献(标明分类体系和分类号)

IPC[7] H01M 10/44 10/46 10/42 H02J 7/00

包含在检索领域中的除最低限度文献以外的检索文献

中国专利数据库

在国际检索时查阅的电子数据库(数据库的名称和，如果实际可行的，使用的检索词)

WPI PAJ EPODOC

C. 相关文件

类 型*	引用文件，必要时，指明相关段落	相关的权利要求编号
A	CN1135103A, 6.11 月 1996(06.11.96), 权利要求 1-26	1-6
A	CN1185860A, 24.6 月 1998 (24.06.98), 全文	1-6
A	US5604418A, 18.2 月 1997(18.02.97), 第 3 栏第 26 行至第 4 栏 24 行, 权利要求 1-4	1-6
A	JP2000-270491A, 29.9 月 2000(29.09.00), 全文	1-6

☐ 其余文件在 C 栏的续页中列出。 ☒ 见同族专利附件。

* 引用文件的专用类型：

"A" 明确叙述了被认为不是特别相关的一般现有技术的文件

"E" 在国际申请日的当天或之后公布的在先的申请或专利

"L" 可能引起对优先权要求的怀疑的文件，为确定另一篇引用文件的公布日而引用的或者因其他特殊理由而引用的文件

"O" 涉及口头公开、使用、展览或其他方式公开的文件

"P" 公布日先于国际申请日但迟于所要求的优先权日的文件

"T" 在申请日或优先权日之后公布的在后文件，它与申请不相抵触，但是引用它是为了理解构成发明基础的理论或原理

"X" 特别相关的文件，仅仅考虑该文件，权利要求所记载的发明就不能认为是新颖的或不能认为是有创造性

"Y" 特别相关的文件，当该文件与另一篇或者多篇该类文件结合并且这种结合对于本领域技术人员为显而易见时，权利要求记载的发明不具有创造性

"&" 同族专利成员的文件

国际检索实际完成的日期	国际检索报告邮寄日期
23.12 月 2002 (23.12.02)	02. 1月 2003(02.01.03)
国际检索单位名称和邮寄地址 ISA/CN 中国北京市海淀区西土城路 6 号(100088) 传真号： 86-10-62019451	受权官员 印 田宏 电话号码： 86-10-62093800

PCT/ISA/210 表(第 2 页)(1998 年 7 月)

国际检索报告
关于同族专利成员的情报

国际申请号
PCT/CN02/00696

检索报告中引用的专利文件	公布日期	同族专利成员	公布日期
CN1135103A	06.11.96	JP3239040B2	17.12.01
		JP8289478 A	01.11.96
		US5654622A	05.08.97
CN1185860A	24.06.98	CA2218709A	28.08.97
		WO9731401A	28.08.97
		US5721067A	24.02.98
		EP0845158AB	03.06.98
		EP19970902122	12.02.97
		JP10512712T	02.12.98
		JP3206604B2	10.09.01
		BR9702193	28.12.99
		DE69707622D	29.11.01
US5604418A	18.02.97	DE69602777E	15.07.99
		EP0729212A1	28.08.96
		FR2731112A1	30.08.96
		FI9600879A	28.08.96
		CA2170315A	28.08.96
		JP8287957A	01.11.96
		CN1137183A	04.12.96
		EP0729212B1	09.06.99
JP2000-270491A	29.09.00	NONE	

10/491134

TRANSLATION

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference IEC020050PCT	**FOR FURTHER ACTION** See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/CN02/00696	International filing date (day/month/year) 28 September 2002(28.09.02)	Priority date *(day/month/year)* 28 September 2001(28.09.01)
International Patent Classification (IPC) or national classification and IPC IPC[7] H01M 10/44 H02J 7/00		
Applicant REN, Xiaoping etc.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and /or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ priority
- III ☐ Non-establishment of opinion with regard to novelty ,inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2)with regard to novelty ,inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international opplication.

Date of submission of the demand	Date of completion of this report
18 April 2003(18.04.03)	06 May 2003(06.05.03)
Name and mailing address of the IPEA/CN 6 Xitucheng Rd., Jimen Bridge, Haidian District, 100088 Beijing, China Facsimile No. 86-10-62019451	Authorized officer HAN, Hong Telephone No. 86-10-62093800

Form PCT/IPEA/409(cover sheet)(July 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/CN02/00696

I. Basis of the report

1. With regard to the **elements** of the international application:*

☒ the international application as originally filed

☐ the description:

pages _____ ,as originally filed

pages _____ ,filed with the demand

pages _____ ,filed with the letter of _____

☐ the claims:

pages _____ ,as originally file

pages _____ , as amended (together with any statement)under Article 19

pages _____ ,filed with the demand

pages _____ ,filed with the letter of _____

☐ the drawings:

pages _____ ,as originally filed

pages _____ ,filed with the demand

pages _____ ,filed with the letter of _____

☐ the sequence listing part of the description:

pages _____ ,as originally filed

pages _____ ,filed with the demand

pages _____ ,filed with the letter of _____

2. with regard to the **language** ,all the elements marked above were available or furnished to this Authority in the language in which the international application was filed,unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search search (under Rule 23.1(b)).

☐ the language of publication of the international application(under Rule 48.3(b)).

☐ the banguage of the translation furnished for the purposes of international preliminary examination (under Ruls Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application,the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description,pages _____

☐ the claims Noa. _____

☐ the drawings,sheets/fig _____

5. ☐ This report has been established as if (some of)the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments(Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.*

Form PCT/IPEA/409(Box I) (July 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/CN02/00696

V. **Reasoned statement under Article 35(2)with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement:

Novelty (N)	Claims	1-6	YES
	Claims		NO
Inventive step (IS)	Claims	1-6	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-6	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

Claims 1-6 meet the criteria set out in PCT Article 33(2)-(4), because the prior art dose not teach or fairly suggest the method for improving capacity, average operating voltage and specific energy of a secondary lithium-ion cell or battery as claim 1, the secondary lithium-ion cell or battery as claims 2-3, the protecting circuit as claim 4, the electronic device as claim 5, and the charging device as claim 6.

10/491134

专 利 合 作 条 约

PCT

REC'D 28 MAY 2003
WIPO PCT

REC'D 28 MAY
WIPO

国际初步审查报告

(PCT 条约 36 和细则 70)

申请人或代理人的档案号 IEC020050PCT	关于后续行为 参见"传送国际初步审查报告的通知"(PCT/IPEA/416 表)	
国际申请号 PCT/CN02/00696	国际申请日 *(日/月/年)* 28. 9 月 2002(28.09.02)	优先权日 *(日/月/年)* 28. 9 月 2001(28.09.01)
国际专利分类(IPC)或者国家分类和 IPC 两种分类 IPC[7] H01M 10/44 H02J 7/00		
申请人 任晓平 等		

1. 本国际初步审查单位已作出国际初步审查报告并依照条约第 36 条将其传送给申请人。

2. 本报告共计 3 页，包括扉页。

☐ 本报告还有附件，即修改后的并且作为本报告基础的说明书修改页、权利要求书修改页和/或附图修改页，和/或对本国际初步审查单位所作出的更正页(见 PCT 细则 70.16 和行政规程 607)。

这些附件共计_____页

3. 本报告包括关于下列各项的内容：

I ☒ 报告的基础

II ☐ 优先权

III ☐ 不作出关于新颖性、创造性和工业实用性的意见

IV ☐ 缺乏发明的单一性

V ☒ 按条约 35(2)关于新颖性、创造性或工业实用性的推断性意见；支持这种意见的引证和解释

VI ☐ 引用的某些文件

VII ☐ 国际申请中的某些缺陷

VIII ☐ 对国际申请的某些意见

提交要求书的日期 18.4 月 2003（18.04.03）	完成本报告的日期 06.5 月 2003（06.05.03）
国际初步审查单位名称和地址 IPEA/CN 中国北京市海淀区西土城路 6 号(100088) 传真号：86-10-62019451	受权官员 印 国宏 电话号码：86-10-62093800

PCT/IPEA/409 表(扉页)(1998 年 7 月)

国际初步审查报告

国际申请号
PCT/CN02/00696

I. 报告的基础

1. 关于国际申请中各个部分：*

☒ 原始提交的国际申请。

☐ 说明书，第_____页，原始提交的，
第_____页，随要求书提交的，
第_____页，随_____的信件提交的。

☐ 权利要求，第_____页，原始提交的，
第_____页，按条约第 19 条修改的(附有说明)，
第_____页，随要求书提交的。
第_____页，随_____的信件提交的。

☐ 附图，第_____页，原始提交的。
第_____页，随要求书提交的，
第_____页，_____的信件提交的。

☐ 说明书中的序列表部分
第_____页，原始要求提交的，
第_____页，随要求书提交的，
第_____页，_____的信件提交的。

2. 关于所使用的语言，除本项下另有说明外，本国际初步审查单位所获得的或者已向本国际初步审查单位提交的上述所有部分，所使用的语言均为提交本国际申请时所使用的语言。
本国际初步审查单位所获得的或向本国际初步审查单位提交的这些部分所使用的语言是_____，这种语言是

☐ 为了国际检索而提交的译本所使用的语言（细则 23.1（b））。
☐ 本国际申请公布时所使用的语言（细则 48.3（b））。
☐ 为了国际初步审查而提交的译本所使用的语言（细则 55.2 和/或 55.3）。

3. 关于本国际申请中所公开的任何核甙酸和/或氨基酸的序列，本国际初步审查是根据下面的序列表进行的：

☐ 国际申请中所包含的书写形式的序列表 。
☐ 与国际申请同时提交的计算机可读形式的序列表。
☐ 后来以书写形式向本国际初步审查单位提交的序列表。
☐ 后来以计算机可读的形式向本国际初步审查单位提交的序列表。
☐ 已提交了关于后来提交的书写形式的序列表没有超出原始提交的国际申请所公开的范围的说明。
☐ 已提交了关于以计算机可读的形式记载的信息是与书写形式的序列表相同的说明。

4. 修改删除了以下内容的：

☐说明书，第_____页
☐权利要求，第_____项
☐附图，第_____页或图_____

5. ☐ 由于（某些）修改被认为超出了原始公开的范围，如补充栏所示，因此本报告是按照如同没有修改的情况作出的(细则 70.2(c))。

* 按照条约第 14 条答复通知时向受理局提交的替换页，在本报告中被称为“原始提交的”，这些替换页不作为本报告的附件，因为它们没有包含修改（细则 70.16 和 70.17）。

** 任何包含这种修改的替换页，都必须在第 1 项中指明，并作为本报告的附件。

国际初步审查报告

国际申请号
PCT/CN02/00696

V. 按条约 35 条(2)关于新颖性、创造性或工业实用性的推断性意见；支持这种意见的引证和解释

1. 意见

新颖性(N)	权利要求	1-6	是
	权利要求		否
创造性(IS)	权利要求	1-6	是
	权利要求		否
工业实用性(IA)	权利要求	1-6	是
	权利要求		否

2. 引证和解释（细则 70.7）

由于现有技术中没有公开独立权利要求 1 的提高二次锂离子电池或电池组特性的方法，独立权利要求 2 的二次锂离子电池或电池组，独立权利要求 4 的保护电路，独立权利要求 5 的电子装置以及独立权利要求 6 的充电装置，因此权利要求 1-6 符合专利合作条约第 33 条第(2)-(4)款的规定。