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(54) **LITHIUM ELECTROLYTE AND APPLICATION THEREOF IN GRAPHITE FLUORIDE SECONDARY BATTERY**

(57) The present invention relates to the technical field of batteries, and in particular to a lithium electrolyte and an application thereof in a graphite fluoride secondary battery. The lithium electrolyte includes an electrolyte and an organic solvent; the electrolyte mainly includes lithium iodide, and the organic solvent is N,N-Dimethylpropyleneurea. Experimental results show that when the lithium electrolyte is used, the first-cycle output of commercial graphite fluoride cathodes is close to a specific capacity of a theoretical value, reversible charge and discharge can be realized within a voltage range of 2-3.4 V (vs. Li/Li^+) subsequently, stable circulation is performed by more than 20 cycles, the discharge voltage platform is near 3.2 V (vs. Li/Li^+), and the discharge capacity can reach 250 mAh g^{-1}. Moreover, the lithium electrolyte involved in the present invention is well compatible with waste graphite fluoride cathodes and porous carbon-lithium fluoride mixture electrodes.

LITHIUM ELECTROLYTE AND APPLICATION THEREOF IN GRAPHITE FLUORIDE SECONDARY BATTERY

TECHNICAL FIELD

[01] The present invention relates to the technical field of batteries, and in particular to a lithium electrolyte and an application thereof in a graphite fluoride secondary battery.

BACKGROUND ART

[02] The development of human society is closely related to the progress of energy technology. Efficient energy production, transportation and storage are the themes of modern electric society. By 2025, the sales volume of new vehicles of new energy vehicles will reach about 20% of the total sales volume of new vehicles. A high-performance and low-cost rechargeable storage technology is the key to realize green development. At present, graphite fluoride (CF_X) is widely applied as the cathode material in primary lithium batteries due to its high specific capacity (865 mAh g^{-1} for x=1), high energy density (2,180 Wh kg^{-1}) and low self-discharge rate.

[03] The working mechanism of CF_X electrode is: $xLi^{+} + CF_X \rightarrow xLiF + C$, which is accompanied by the formation of solid electrolyte interfacial films, recombination of electrode structure and other phenomena. Considering the solvation of Li^+ cations, both the working potential and kinetic process of the battery are affected by electrolyte salt concentration and solvent type. Due to the C-F covalent bond, CF_X has a poor electric conductivity and a slow electrode reaction rate. Moreover, the electrode reaction product LiF causes great electrode structure damage and is difficult to decompose under moderate conditions. Therefore, reversible energy storage has still to be realized in Li/CF_X battery systems, and the resource waste and environmental pollution caused by waste batteries are self-evident.

SUMMARY

[04] The objective of the present invention is to solve the irreversibility of Li/CF_X batteries. When the lithium electrolyte provided by the present invention is used, the high initial energy output of commercial CF_X cathode is ensured, and a reversible specific capacity of about 200 mAh g^{-1} between 2 V-3.4 V (vs. Li/Li^+) can be achieved.

Moreover, the electrolyte provided by the present invention is well compatible with waste CF_x electrodes and porous carbon-lithium fluoride mixture electrodes.

[05] To achieve the aforesaid objective, the present invention provides a lithium electrolyte, and such lithium electrolyte is applied in a Li/CF_x battery to realize reversible charge and discharge of CF_x cathodes:

[06] In the above-mentioned technical solution, the lithium electrolyte includes an electrolyte and an organic solvent.

[07] In the above-mentioned technical solution, the organic solvent is N,N-Dimethylpropyleneurea (DMPU).

[08] In the above-mentioned technical solution, the lithium salt is lithium iodide, and a molarity of the lithium salt in the organic solvent is 0.5 mol L^{-1} - saturated.

[09] In the above-mentioned technical solution, an anode material of the Li/CF_x battery is at least one of lithium metal, graphite and lithium titanate, and the separator is glass fiber filter.

[10] In the above-mentioned technical solution, an electrolyte of the Li/CF_x battery is the lithium electrolyte described herein.

[11] In the above-mentioned technical solution, a cathode material of the graphite fluoride secondary battery is graphite fluoride, or waste graphite fluoride, or carbon fluoride, or a porous carbon-lithium fluoride mixture.

[12] In the above-mentioned technical solution, a molar ratio of the fluorine to the carbon in the cathode material of the Li/CF_x battery is 0.01-0.99.

[13] Compared with the prior art, the present invention has the following beneficial effects: The lithium electrolyte provided by the present invention is low-cost, easy to obtain and simple to prepare. Reversible charge and discharge can be realized for the Li/CF_x battery containing the lithium electrolyte provided by the present invention. The initial discharge capacity of the battery using commercial CF_x cathode ($CF_{0.56}$ and $CF_{0.66}$) reaches 600 mAh g^{-1} and 1,120 mAh g^{-1} respectively, and the battery can cycle more than 20 times between 2 V-3.4 V (vs. Li/Li^+) subsequently with an output capacity fluctuates within a range of 100 mAh g^{-1}-300 mAh g^{-1}. In particular, it is worth mentioning that the lithium electrolyte provided by the present invention has a good effect on the CF_x electrodes from waste batteries and the porous carbon-lithium fluoride mixture electrodes, exhibiting a good compatibility and commercialization potential.

BRIEF DESCRIPTION OF THE DRAWINGS

[14] The present invention will be further described below in detail in combination with accompanying drawings and specific embodiments:

[15] FIG. 1 shows a voltage-specific capacity curve in the first 3 cycles of the batteries prepared in examples 1-3 of the present invention.

[16] FIG. 2 shows a voltage-specific capacity curve in the first 3 cycles of the batteries prepared in examples 3-5 of the present invention.

[17] FIG. 3 shows a correlation graph among a specific discharge capacity, a coulombic efficiency and a cycle index of the batteries prepared in examples 3-5 of the present invention.

[18] FIG. 4 shows a voltage-specific capacity curve in the first 3 cycles of the batteries prepared in examples 6 and 7 of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[19] The technical solutions of the present invention will be described below clearly and completely in combination with the embodiments. It is obvious that the described embodiments are only a part of, rather than all of, the embodiments of the present invention. On the basis of the embodiments in the present invention, all the other embodiments obtained by those of ordinary skill in the art without making creative efforts should fall into the protection scope of the present invention.

[20] There is no special limitation to sources of all the raw materials used in the following embodiments, and these raw materials can be commercially available or can be prepared according to conventional methods known to those skilled in the art. There is no special requirement for a preparation process of the electrodes used, and the electrodes can be prepared according to conventional methods known to those skilled in the art.

[21] Example 1

[22] A 0.5 mol L^{-1} lithium iodide solution was prepared in a glove box, with a solvent of DMPU. The prepared solution was kept static for 12 h. With the resulting solution as an electrolyte, a CR2302 coin cell was assembled in the glove box, wherein an anode was a lithium sheet, a cathode was graphite fluoride ($CF_{0.56}$), a separator was glass fiber filter, and an electrolyte dosage was 200 μL. The assembled battery was kept static at 25°C for 12 h, discharged to 2 V at a current density of 0.05 A g^{-1}, and subjected to constant current charge-discharge test within a voltage range of 2 V-3.4 V.

[23] As shown in FIG. 1, an initial discharge voltage platform of the battery was 2.25 V-2.3 V (vs. Li/Li^+), and a discharge capacity was about 330 mAh g^{-1}. In the subsequent cycle, reversible capacity of about 50 mAh g^{-1} can be realized for the battery, and the discharge voltage platform was near 3.2 V (vs. Li/Li^+). It was indicated that the graphite fluoride ($CF_{0.56}$) cathode had certain reversibility in the 0.5 mol L^{-1} lithium iodide solution.

[24] Example 2

[25] A saturated (about 1.4 mol L^{-1}) lithium iodide solution was prepared in a glove box, with a solvent of DMPU. The prepared solution was kept static for 12 h. With the resulting solution as an electrolyte, a CR2302 coin cell was assembled in the glove box, wherein an anode was a lithium sheet, a cathode was graphite fluoride ($CF_{0.56}$), a separator was glass fiber filter, and an electrolyte dosage was 200 μL. The assembled battery was kept static at 25°C for 12 h, discharged to 2 V at a current density of 0.05 A g^{-1}, and subjected to constant current charge-discharge test within a voltage range of 2 V-3.4 V.

[26] As shown in FIG. 1, as the viscosity of the saturated lithium iodide solution is high and the ionic movement is difficult, an initial discharge voltage platform of the battery was 2.0 V-2.2 V (vs. Li/Li^+), and a discharge capacity was about 90 mAh g^{-1}. The subsequent reversible capacity of the battery kept stable at about 170 mAh g^{-1}, and the discharge voltage platform was near 3.2 V (vs. Li/Li^+), indicating that the graphite fluoride ($CF_{0.56}$) cathode had a high reversible capacity in the saturated lithium iodide solution.

[27] Example 3

[28] A 1 mol L^{-1} lithium iodide solution was prepared in a glove box, with a solvent of DMPU. The prepared solution was kept static for 12 h. With the resulting solution as an electrolyte, a CR2302 coin cell was assembled in the glove box, wherein an anode was a lithium sheet, a cathode was graphite fluoride ($CF_{0.56}$), a separator was glass fiber filter, and an electrolyte dosage was 200 μL. The assembled battery was kept static at 25°C for 12 h, and subjected to constant current charge-discharge test within a voltage range of 2 V-3.4 V at a current density of 0.05 A g^{-1}.

[29] From FIG. 1, it can be seen that an initial discharge voltage platform of the battery was 2.25 V-2.5 V (vs. Li/Li^+), and a discharge capacity was about 600 mAh g^{-1};

the subsequent reversible capacity reached 150 mAh g^{-1}, and the discharge voltage platform was near 3.2 V (vs. Li/Li^{+}), indicating that the graphite fluoride ($CF_{0.56}$) cathode could provide a high reversible capacity in the 1 mol L^{-1} lithium iodide solution, and the battery performance was better.

[30] As shown in FIG. 3, the battery could realize more than 20 cycles in a voltage range of 2 V-3.4 V, the discharge capacity of the battery fluctuated within a range of 125 mAh g^{-1}-225 mAh g^{-1}, and a coulombic efficiency also fluctuated near 50%, indicating that the graphite fluoride ($CF_{0.56}$) cathode could realize stable charge-discharge cycles to a certain extent.

[31] Example 4

[32] A 1 mol L^{-1} lithium iodide solution was prepared in a glove box, with a solvent of DMPU. The prepared solution was kept static for 12 h. With the resulting solution as an electrolyte, a CR2302 coin cell was assembled in the glove box, wherein an anode was a lithium sheet, a cathode was graphite fluoride ($CF_{0.66}$), a separator was glass fiber filter, and an electrolyte dosage was 200 μL. The assembled battery was kept static at 25°C for 12 h, discharged to 2 V at a current density of 0.05 A g^{-1}, and subjected to constant current charge-discharge test within a voltage range of 2 V-3.4 V.

[33] As shown in FIG. 2, an initial discharge voltage platform of the battery was 2.25 V-2.3 V (vs. Li/Li^{+}), and a discharge capacity was about 1,120 mAh g^{-1}. Considering some experimental errors and an adsorption capacity of porous carbon, the performance of the electrode was close to a theoretical limit capacity (1,094 mAh g^{-1}) of $CF_{0.66}$. Moreover, the subsequent discharge voltage platform of the battery was near 3.2 V (vs. Li/Li^{+}), and the discharge capacity reached 300 mAh g^{-1}, indicating that the graphite fluoride ($CF_{0.66}$) cathode could provide a high reversible capacity in the 1 mol L^{-1} lithium iodide solution, and the battery performance was better.

[34] From FIG. 3, it can be seen that the battery could realize more than 20 cycles in a voltage range of 2 V-3.4 V, the discharge capacity of the battery fluctuated within a range of 250 mAh g^{-1}-310 mAh g^{-1}, and a coulombic efficiency was between 60%-70%, indicating that the graphite fluoride ($CF_{0.66}$) cathode had a better cyclic stability.

[35] Example 5

[36] A 1 mol L^{-1} lithium iodide solution was prepared in a glove box, with a solvent of DMPU. The prepared solution was kept static for 12 h. With the resulting solution as an electrolyte, a CR2302 coin cell was assembled in the glove box, wherein an anode was a lithium sheet, a cathode was graphite fluoride ($CF_{0.99}$), a separator was glass fiber filter, and an electrolyte dosage was 200 μL. The assembled battery was kept static at 25°C for 12 h, discharged to 2 V at a current density of 0.05 A g^{-1}, and subjected to constant current charge-discharge test within a voltage range of 2 V-3.4 V.

[37] As shown in FIG. 2, an initial discharge voltage platform of the battery was 2.25 V-2.5 V (vs. Li/Li^+), and a discharge capacity was about 800 mAh g^{-1}. Considering some experimental errors and an adsorption capacity of porous carbon, the performance of the electrode was close to a theoretical limit capacity (865 mAh g^{-1}) of $CF_{0.99}$. Moreover, the subsequent discharge voltage platform of the battery was near 3.2 V (vs. Li/Li^+), and the discharge capacity was stable at about 200 mAh g^{-1}, indicating that the graphite fluoride ($CF_{0.99}$) cathode could provide a high reversible capacity in the 1 mol L^{-1} lithium iodide solution, and the battery performance was better.

[38] From FIG. 3, it can be seen that the battery could realize more than 30 cycles in a voltage range of 2 V-3.4 V, the discharge capacity of the battery fluctuated near 250 mAh g^{-1}, and a coulombic efficiency was maintained near 60%, indicating that the graphite fluoride ($CF_{0.99}$) cathode had a better cyclic stability.

[39] Example 6

[40] A 1 mol L^{-1} lithium iodide solution was prepared in a glove box, with a solvent of DMPU. The prepared solution was kept static for 12 h. With the resulting solution as an electrolyte, a CR2302 coin cell was assembled in the glove box, wherein an anode was a lithium sheet, a cathode was a waste graphite fluoride ($CF_{0.56}$) electrode (note: the electrode was removed from a waste graphite fluoride primary battery, and used after immersing and washing with DMPU), a separator was glass fiber filter, and an electrolyte dosage was 200 μL. The assembled battery was kept static at 25°C for 12 h, and subjected to constant current charge-discharge test within a voltage range of 2 V-3.4 V at a current density of 0.05 A g^{-1}.

[41] As shown in FIG. 4, the waste graphite fluoride ($CF_{0.56}$) cathode could realize reversible charge and discharge within 2 V-3.4 V, a discharge voltage platform was near 3.25 V (vs. Li/Li^+), and a discharge capacity was maintained at about 200 mAh g^{-1}, indicating that the 1 mol L^{-1} lithium iodide solution was well compatible with the waste graphite fluoride ($CF_{0.56}$) cathode.

[42] Example 7

[43] A 1 mol L^{-1} lithium iodide solution was prepared in a glove box, with a solvent of DMPU. The prepared solution was kept static for 12 h. With the resulting solution as an electrolyte, a CR2302 coin cell was assembled in the glove box, wherein an anode was a lithium sheet, a cathode was a porous carbon-lithium fluoride mixture (C: LiF = 1:1 by mol.), a separator was glass fiber filter, and an electrolyte dosage was 200 μL. The assembled battery was kept static at 25°C for 12 h, and subjected to constant current charge-discharge test within a voltage range of 2 V-3.4 V at a current density of 0.05 A g^{-1}.

[44] As shown in FIG. 4, the porous carbon-lithium fluoride mixture cathode could realize reversible charge and discharge within 2 V-3.4 V, and an initial specific discharge capacity of the battery was about 300 mAh g^{-1}, and gradually decreased with an increased number of cycles, indicating that the 1 mol L^{-1} lithium iodide solution could be compatible with the porous carbon-lithium fluoride mixture cathode.

[45] The above-mentioned description of the embodiments is only used to help understand the method of the present invention and its core idea. It should be noted that some improvements and modifications may also be made by those of ordinary skill in the art without departing from the principles of the present invention, and such improvements and modifications should also fall into the protection scope of the claims of the present invention.

[46] The above-mentioned description of the disclosed embodiments enables the realization and use of the present invention by those skilled in the art. Various modifications to these embodiments will be obvious to those skilled in the art, and the general principles defined herein may be realized in other embodiments without departing from the spirit or scope of the present invention. Therefore, the present invention will not be limited to these embodiments shown herein, but should accord with the widest extent consistent with the principles and novel features disclosed herein.

Conclusies

1. Lithiumelektrolyt, omvattende een elektrolytzout en een organisch oplosmiddel.

2. Lithiumelektrolyt volgens conclusie 1, waarbij het organische oplosmiddel N,N-dimethylpropyleenureum is.

3. Lithiumelektrolyt volgens conclusie 1, waarbij het elektrolytzout hoofdzakelijk lithiumjodide omvat, en een molariteit van het elektrolytzout in het organische oplosmiddel 0,5 mol L^{-1}-verzadigd is.

4. Secundaire grafietfluoridebatterij, die is vervaardigd van het lithiumelektrolyt volgens conclusie 1.

5. Secundaire grafietfluoridebatterij volgens conclusie 4, waarbij de batterij hoofdzakelijk een kathodemateriaal, een anodemateriaal en een elektrolyt omvat.

6. Secundaire grafietfluoridebatterij volgens conclusie 5, waarbij het kathodemateriaal ten minste één van grafietfluoride, gefluoreerde koolstof en een poreus mengsel van koolstof en lithiumfluoride is; het anodemateriaal ten minste één van lithiummetaal, grafiet en lithiumtitanaat is; de elektrolyt als beschreven in conclusie 1 is.

7. Kathodemateriaal volgens conclusie 6, waarbij een molaire verhouding van het fluor tot de koolstof in het kathodemateriaal 0,01-0,99 is; het grafietfluoride mag commercieel beschikbare producten zijn of mag verkregen zijn van afgedankte primaire grafietfluoridebatterijen op basis van lithium.

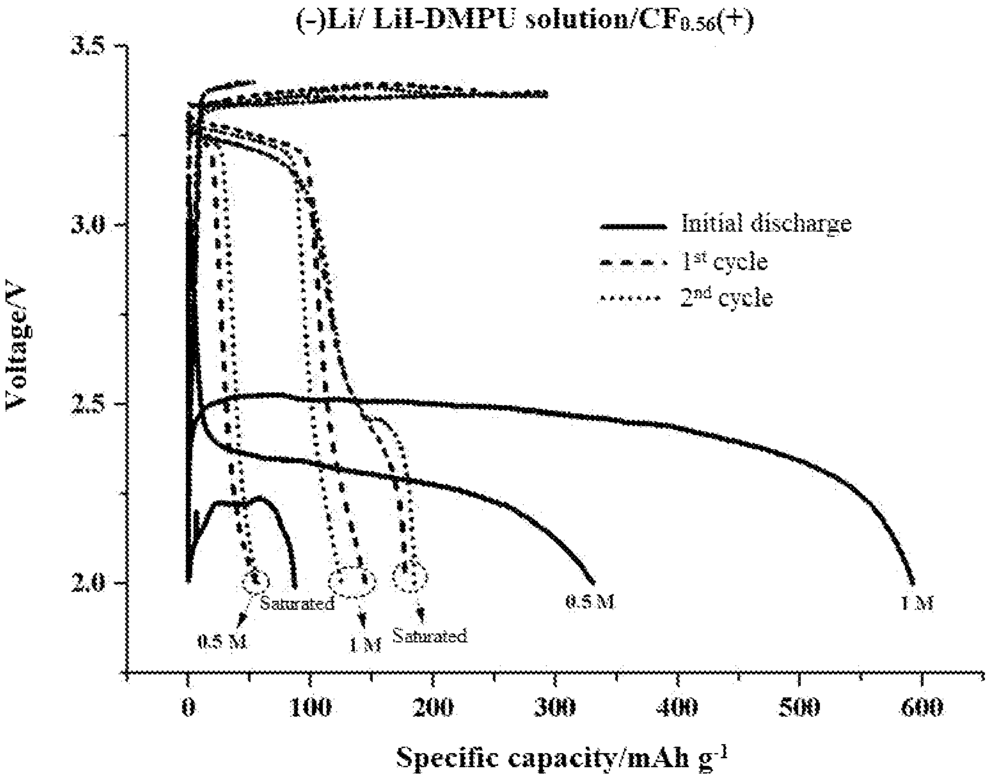
(-)Li/ LiI-DMPU solution/CF0.56(+)
Voltage/V
Specific capacity/mAh g-1
Initial discharge
1st cycle
2nd cycle
Saturated
0.5 M
1 M
Saturated
0.5 M
1 M
3.5
3.0
2.5
2.0
0
100
200
300
400
500
600

FIG. 1

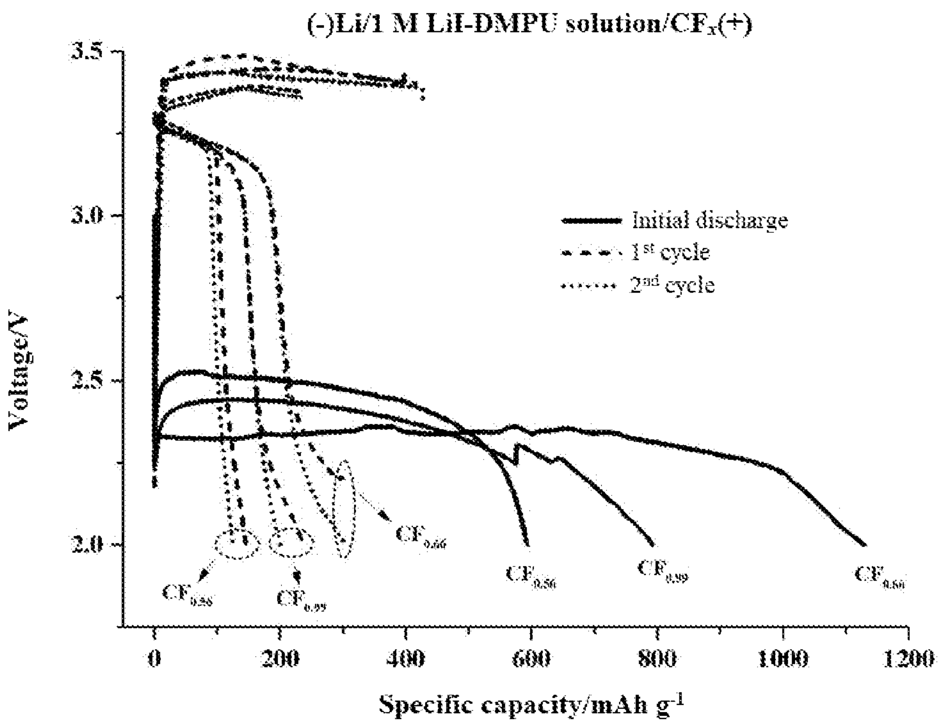
(-)Li/1 M LiI-DMPU solution/CFx(+)
Voltage/V
Specific capacity/mAh g-1
Initial discharge
1st cycle
2nd cycle
CF0.66
CF0.56
CF0.99
CF0.56
CF0.99
CF0.66
3.5
3.0
2.5
2.0
0
200
400
600
800
1000
1200

FIG. 2

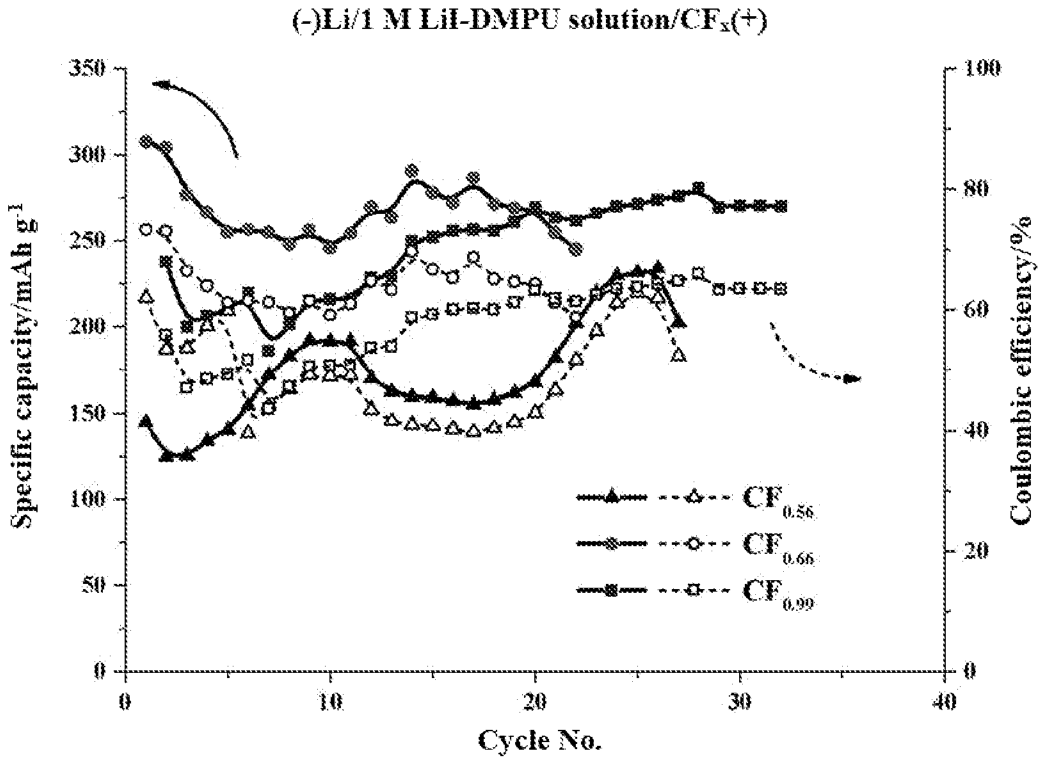
(-)Li/1 M LiI-DMPU solution/CF_x(+)
Specific capacity/mAh g-1
Coulombic efficiency/%
Cycle No.
$CF_{0.56}$
$CF_{0.66}$
$CF_{0.99}$

FIG. 3

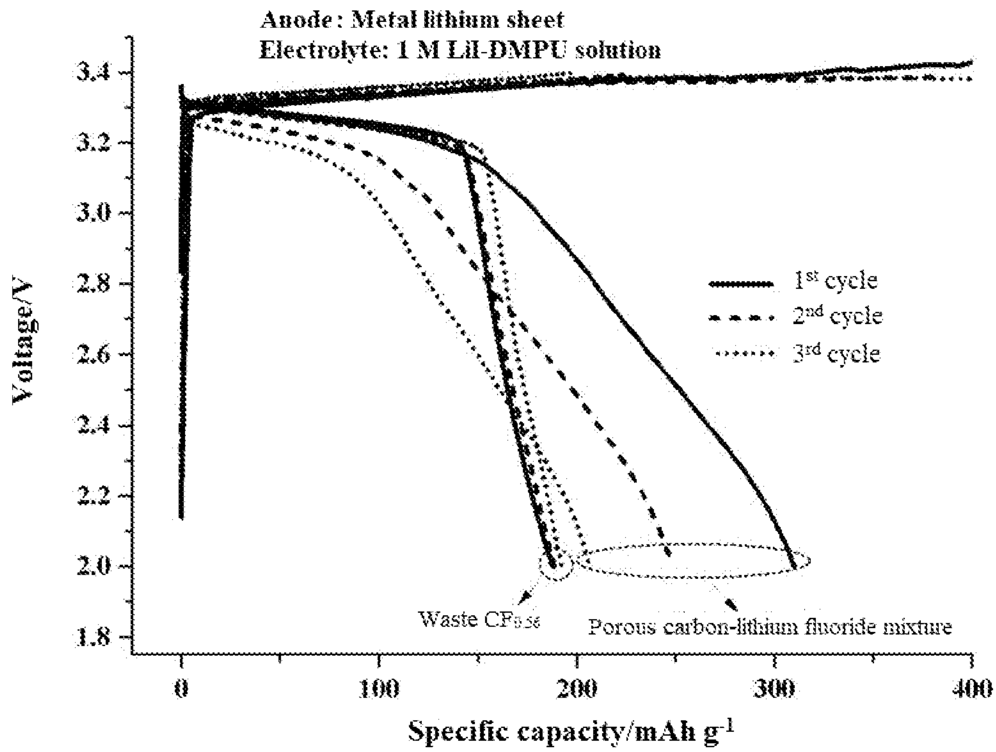
Anode: Metal lithium sheet
Electrolyte: 1 M LiI-DMPU solution
Voltage/V
Specific capacity/mAh g-1
1st cycle
2nd cycle
3rd cycle
Waste $CF_{0.56}$
Porous carbon-lithium fluoride mixture

FIG. 4

Rijksdienst voor Ondernemend Nederland

OCTROOIAANVRAAG NR.:

NO 143157
NL 2035104

ONDERZOEKSRAPPORT

BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK

RELEVANTE LITERATUUR

Categorie[1]	Literatuur met, voor zover nodig, aanduiding van speciaal van belang zijnde tekstgedeelten of figuren.	Van belang voor conclusie(s) nr:	Classificatie(IPC)
X	US 9 991 493 B2 (EAGLEPICHER TECHNOLOGIES LLC [US]) 5 juni 2018 (2018-06-05) * conclusies 1,12 * * kolom 9, regel 1 - regel 30 * * kolom 4, regel 47 - regel 52 * -----	1-7	INV. H01M4/583 H01M4/587 H01M10/0568 H01M10/0569 H01M4/02 H01M4/485

Onderzochte gebieden van de techniek

H01M

Indien gewijzigde conclusies zijn ingediend, heeft dit rapport betrekking op de conclusies ingediend op:

Plaats van onderzoek:	Datum waarop het onderzoek werd voltooid:	Bevoegd ambtenaar:
's-Gravenhage	27 oktober 2023	Domínguez Gutiérrez

[1] NDERLINCATEGORIE VAN DE VERMELDE LITERATUUR

X: de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur
Y: de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht
A: niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft
O: niet-schriftelijke stand van de techniek
P: tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

T: na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding
E: eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven
D: in de octrooiaanvrage vermeld
L: om andere redenen vermelde literatuur
&: lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

AANHANGSEL BEHORENDE BIJ HET RAPPORT BETREFFENDE HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK, UITGEVOERD IN DE OCTROOIAANVRAGE NR.

NO 143157
NL 2035104

Het aanhangsel bevat een opgave van elders gepubliceerde octrooiaanvragen of octrooien (zogenaamde leden van dezelfde octrooifamilie), die overeenkomen met octrooischriften genoemd in het rapport.
De opgave is samengesteld aan de hand van gegevens uit het computerbestand van het Europees Octrooibureau per
De juistheid en volledigheid van deze opgave wordt noch door het Europees Octrooibureau, noch door het Bureau voor de Industriële eigendom gegarandeerd;; de gegevens worden verstrekt voor informatiedoeleinden.

27-10-2023

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
US 9991493 B2	05-06-2018	US 2016359158 A1	08-12-2016
		WO 2015057808 A1	23-04-2015

EPO FORM P0466

Algemene informatie over dit aanhangsel is gepubliceerd in de 'Official Journal' van het Europees Octrooibureau nr 12/82 blz 448 ev

SCHRIFTELIJKE OPINIE

DOSSIER NUMMER	INDIENINGSDATUM	VOORRANGSDATUM	AANVRAAGNUMMER
NO143157	15.06.2023	16.06.2022	NL2035104

CLASSIFICATIE
INV. H01M4/583 H01M4/587 H01M10/0568 H01M10/0569 H01M4/02 H01M4/485

AANVRAGER
Hainan Normal University

Deze schriftelijke opinie bevat een toelichting op de volgende onderdelen:

- ☒ Onderdeel I Basis van de schriftelijke opinie
- ☐ Onderdeel II Voorrang
- ☐ Onderdeel III Vaststelling nieuwheid, inventiviteit en industriële toepasbaarheid niet mogelijk
- ☐ Onderdeel IV De aanvraag heeft betrekking op meer dan één uitvinding
- ☒ Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid
- ☐ Onderdeel VI Andere geciteerde documenten
- ☐ Onderdeel VII Overige gebreken
- ☒ Onderdeel VIII Overige opmerkingen

DE BEVOEGDE AMBTENAAR

Domínguez Gutiérrez

SCHRIFTELIJKE OPINIE

Onderdeel I Basis van de Schriftelijke Opinie

1. Deze schriftelijke opinie is opgesteld op basis van de meest recente conclusies ingediend voor aanvang van het onderzoek.
2. Deze motivering is opgesteld, met betrekking tot **nucleotide- en/of aminozuursequenties** die genoemd worden in de aanvraag, op basis van een sequentielijst die:

   a. ☐ is opgenomen in de aanvraag zoals deze oorspronkelijk is ingediend

   b. ☐ aangeleverd is na de indieningsdatum ten behoeve van het onderzoek

   ☐ en vergezeld ging van een verklaring dat de sequentielijst niet meer informatie bevat dan de aanvraag zoals deze oorspronkelijk is ingediend.

3. ☐ Deze motivering is opgesteld, met betrekking tot nucleotide- en/of aminozuursequenties die genoemd worden in de aanvraag, voor zover een zinvolle motivering gevormd kon worden zonder een sequentielijst die voldeed aan WIPO standaard ST.26.
4. Overige opmerkingen:

Onderdeel V Gemotiveerde verklaring ten aanzien van nieuwheid, inventiviteit en industriële toepasbaarheid

1. Verklaring

Nieuwheid	Ja:	Conclusies	2, 3
	Nee:	Conclusies	1, 4-7
Inventiviteit	Ja:	Conclusies	
	Nee:	Conclusies	1-7
Industriële toepasbaarheid	Ja:	Conclusies	1-7
	Nee:	Conclusies	

2. Citaties en toelichting:

Zie aparte bladzijde

Onderdeel VIII Overige opmerkingen

De volgende opmerkingen met betrekking tot de duidelijkheid van de conclusies, beschrijving, en figuren, of met betrekking tot de vraag of de conclusies nawerkbaar zijn, worden gemaakt:

Zie aparte bladzijde

<u>Re Item V</u>

1. Prior art.

Reference is made to the following document:

D1: US 9 991 493 B2 (EAGLEPICHER TECHNOLOGIES LLC [US]) 5 juni 2018 (2018-06-05)

2. Clarity.

Claim 6 is not clear because it has been drafted as a "graphite fluoride" battery, but it contains an option in which there is no fluorinated graphite/carbon. The option "porous mixture of carbon and lithium fluoride" should be deleted.

3. Novelty.

The present application does not meet the criteria of patentability, because the subject-matter of claims 1, 4-7 is not new.
D1 discloses (cf passages in search report) a non-aqueous electrochemical cell that can be used in secondary batteries comprising an anode including an anode material comprising lithium metal foil; a cathode including a cathode material comprising carbon monofluoride (CFx), with x being between 0.1 and 1.9; and a non-aqueous electrolyte having a non-aqueous solvent and one or more lithium salts.

4. Inventive step.

Claims 2 and 3 refer to very well-known components employed in electrolytes that have been used for decades, belonging to the list of most obvious components of non-aqueous electrolytic solutions.

<u>Re Item VIII</u>

5. Clarity, lack of support.

Claims 1 and 2 relate to lithium electrolytic solutions of a salt and an organic solvent as DMPU. The use of lithium salts in organic solvents started in the late 1970s, while DMPU is considered a very common and useful polar aprotic solvent due to its high dielectric constant, low viscosity, and ability to dissolve a wide range of salts used in electrolytes.

There is a countless amount of references using these features. There is no justification for seeking protection for such a broad scope. These claims thus lack support.

This is a fundamental lack of clarity.