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Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(88) Date of publication of the international search report:

16 February 2017



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(54) Title: ELECTROLYTE FORMULATIONS FOR LITHIUM ION BATTERIES

(57) Abstract: Electrolyte formulations including additives or combinations of additives. The electrolyte formulations are useful in lithium ion battery cells having lithium titanate anodes. The electrolyte formulations provide low temperature power performance and high temperature stability in such lithium ion battery cells.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/038575**A. CLASSIFICATION OF SUBJECT MATTER****H01M 10/0525(2010.01)i, H01M 10/0567(2010.01)i, H01M 4/13(2010.01)i**

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)

H01M 10/0525; H01M 10/0567; H01M 4/525; H01M 10/0564; H01M 6/18; H01M 10/0569; H01M 12/02; H01M 6/16; H01M 10/052; H01M 10/0568; H01M 4/13

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & keywords: electrolyte, tris(2,2,-trifluoroethyl)borate, methyl 2,2,2-trifluoroethyl carbonate, tris(2,2,2-trifluoroethyl)phosphate, 4,4,5,5-tetramethyl-2-(4-trifluoromethylphenyl)-1,3,2-dioxaborolane, ethyl difluoroacetate, diethyl(difluoromethyl)phosphate

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2014-0023941 A1 (AMINE, KHALIL et al.) 23 January 2014 See claim 1; paragraph [0021].	1, 13, 14
A	WO 2015-073419 A1 (BASF CORPORATION) 21 May 2015 See claims 1-3.	1, 13, 14
X	US 2015-0140444 A1 (E.I. DU PONT DE NEMOURS AND COMPANY) 21 May 2015 See claims 1-2, 7; paragraph [0026].	2, 7, 8, 11
A		9, 10
X	US 2010-0047695 A1 (SMART, MARSHALL C. et al.) 25 February 2010 See claims 13-15, 22; paragraph [0069].	3, 4, 12
A		5, 6
A	US 2013-0071731 A1 (MITSUBISHI CHEMICAL CORPORATION) 21 March 2013 See claims 1, 5, 9.	3-6, 12

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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17 January 2017 (17.01.2017)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/038575**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

- Group 1: Claims 1 and 13-14 relate to a lithium battery cell, comprising an electrolyte formulation comprising tris(2,2,2-trifluoroethyl)borate and a fluorinated compound other than tris(2,2,2-trifluoroethyl)borate.
- Group 2: Claims 2 and 7-11 relate to a lithium battery cell, comprising an electrolyte formulation comprising tris(2,2,2-trifluoroethyl)phosphate and a fluorinated compound other than tris(2,2,2-trifluoroethyl)phosphate.
- Group 3: Claims 3-6 and 12 relate to a lithium battery cell, comprising an electrolyte formulation comprising methyl 2,2,2-trifluoroethyl carbonate and a fluorinated compound other than methyl 2,2,2-trifluoroethyl carbonate.

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.
3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2016/038575

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014-0023941 A1	23/01/2014	US 9362599 B2 WO 2012-138844 A2 WO 2012-138844 A3	07/06/2016 11/10/2012 21/03/2013
WO 2015-073419 A1	21/05/2015	CN 105745780 A KR 10-2016-0086838 A US 2015-0140446 A1	06/07/2016 20/07/2016 21/05/2015
US 2015-0140444 A1	21/05/2015	CA 2844466 A1 CA 2844796 A1 CN 103765659 A CN 103959544 A CN 104704657 A EP 2751865 A1 EP 2751866 A1 EP 2856540 A1 JP 2014-525666 A JP 2014-525667 A JP 2015-522915 A KR 10-2014-0060324 A KR 10-2014-0060325 A KR 10-2015-0027073 A US 2014-0227584 A1 US 2014-0248529 A1 WO 2013-033579 A1 WO 2013-033595 A1 WO 2013-180781 A1	07/03/2013 07/03/2013 30/04/2014 30/07/2014 10/06/2015 09/07/2014 09/07/2014 08/04/2015 29/09/2014 29/09/2014 06/08/2015 19/05/2014 19/05/2014 11/03/2015 14/08/2014 04/09/2014 07/03/2013 07/03/2013 05/12/2013
US 2010-0047695 A1	25/02/2010	US 8795903 B2	05/08/2014
US 2013-0071731 A1	21/03/2013	CN 102893442 A EP 2571089 A1 JP 05760665 B2 JP 05760809 B2 JP 05948755 B2 JP 05948756 B2 JP 2011-258548 A JP 2012-054231 A JP 2012-109206 A JP 2012-238561 A KR 10-2013-0069631 A US 2015-0044554 A1 WO 2011-142410 A1	23/01/2013 20/03/2013 12/08/2015 12/08/2015 06/07/2016 06/07/2016 22/12/2011 15/03/2012 07/06/2012 06/12/2012 26/06/2013 12/02/2015 17/11/2011