

(43) International Publication Date
25 September 2014 (25.09.2014)

(51) International Patent Classification:

H01M 4/36 (2006.01) *H01M 4/505* (2010.01)
H01M 4/58 (2010.01) *H01M 4/525* (2010.01)

(21) International Application Number:

PCT/US2014/027125

(22) International Filing Date:

14 March 2014 (14.03.2014)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

13/842,278 15 March 2013 (15.03.2013) US

(71) Applicant: **NANO ONE MATERIALS CORP.**
 [CA/CA]; Suite 620 - 650 W Georgia St., Vancouver, BC
 V6B 4N9 (CA).

(72) Inventor; and

(71) Applicant : **FRIANEZA-KULLBERG, Teresita**
 [US/US]; 2896 Berwick Lane, Gastonia, NC 28054 (US).

(74) Agents: **GUY, Joseph, T.** et al.; Perkins Law Firm, LLC,
 200 N. Main Street, Suite 301, Greenville, SC 29601 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

[Continued on next page]

(54) Title: COMPLEXOMETRIC PRECURSOR FORMULATION METHODOLOGY FOR INDUSTRIAL PRODUCTION OF FINE AND ULTRAFINE POWDERS AND NANOPOWDERS FOR LITHIUM METAL OXIDES FOR BATTERY APPLICATIONS

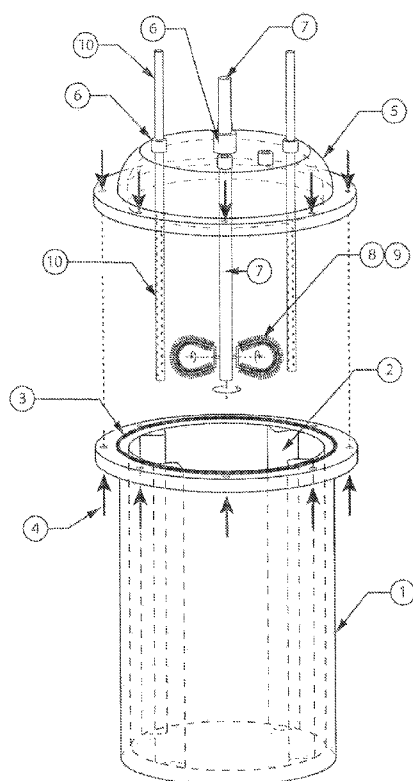


Figure 4

(57) Abstract: A compound M_jX_p which is particularly suitable for use in a battery prepared by the complexometric precursor formulation methodology wherein: M_j is at least one positive ion selected from the group consisting of alkali metals, alkaline earth metals and transition metals and j is an integer representing the moles of said positive ion per moles of said M_jX_p ; and X_p , a negative anion or polyanion from Groups IIIA, IV A, VA, VIA and VIIA and may be one or more anion or polyanion and p is an integer representing the moles of said negative ion per moles of said M_jX_p .



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:**Declarations under Rule 4.17:**

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

- 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:

20 October 2016

A. CLASSIFICATION OF SUBJECT MATTER**H01M 4/36(2006.01)I, H01M 4/58(2010.01)I, H01M 4/505(2010.01)I, H01M 4/525(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 4/36; H01M 4/00; C23C 4/10; H01M 4/38; C23C 16/513; H01M 4/131; H01M 4/54; H01M 4/58; H01M 4/505; H01M 4/525

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: complexometric precursor formulation methodology, Li-Ni-Mn-Co-O₂, dopant, coating, nanostructure, capacity**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011-0274850 A1 (YANG, L. et al.) 10 November 2011 See paragraphs [0020]-[0025] and [0029]; and claims 12-20.	1-27
X	SUN, Y.-K. et al., High-energy cathode material for long-life and safe lithium batteries, Nature Materials, 2009, Vol. 8, No. 4, pp. 320-324 See page 320, right column, last paragraph; Figures 1 and 4c.	1-16, 20-27
X	US 2010-0086853 A1 (VENKATACHALAM, S. et al.) 08 April 2010 See paragraphs [0028] and [0048]-[0051]; and claims 1-18.	1-16, 20-25
X	US 2012-0052391 A1 (SUZUKI, A. et al.) 01 March 2012 See the whole document.	1-16, 20-25
X	US 2012-0164533 A1 (SENOUE, M. et al.) 28 June 2012 See the whole document.	1-16, 20-25



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

12 September 2016 (12.09.2016)

Date of mailing of the international search report

12 September 2016 (12.09.2016)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsu-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

CHO, KI YUN

Telephone No. +82-42-481-5655



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/027125

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011-0274850 A1	10/11/2011	TW 201207152 A US 8967076 B2 WO 2011-139574 A2 WO 2011-139574 A3	16/02/2012 03/03/2015 10/11/2011 05/04/2012
US 2010-0086853 A1	08/04/2010	CN 102177605 A EP 2351122 A2 EP 2351122 A4 JP 2012-505520 A KR 10-2011-0084200 A US 2013-142944 A1 US 8389160 B2 WO 2010-042434 A2 WO 2010-042434 A3	07/09/2011 03/08/2011 09/05/2012 01/03/2012 21/07/2011 06/06/2013 05/03/2013 15/04/2010 08/07/2010
US 2012-0052391 A1	01/03/2012	CN 102386375 A EP 2424012 A2 EP 2424012 A3 JP 2012-048959 A	21/03/2012 29/02/2012 26/09/2012 08/03/2012
US 2012-0164533 A1	28/06/2012	CN 102569878 A JP 2012-142156 A US 9077036 B2	11/07/2012 26/07/2012 07/07/2015