

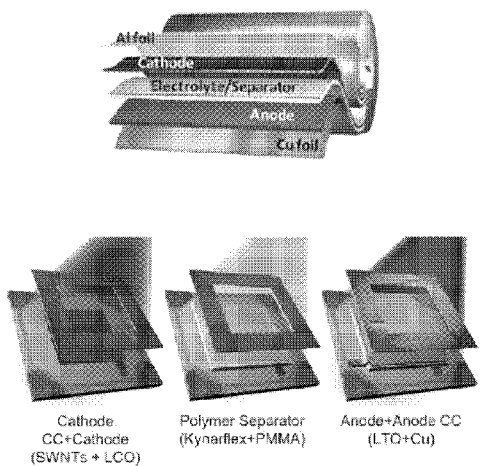


- (51) International Patent Classification:
H01L 31/04 (2006.01)
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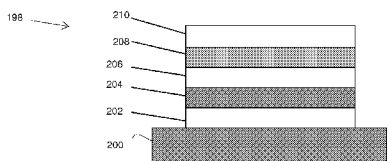
- (74) Agent: AMINI, Farhang; Winstead PC, P.O. Box 131851, Dallas, TX 75313 (US).
- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, 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, 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.
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[Continued on next page]

(54) Title: METHODS OF MAKING MULTILAYER ENERGY STORAGE DEVICES



A
B



C

(57) Abstract: The present invention provides additive manufacturing methods of forming multilayer energy storage devices on a surface by formulating all components of the multilayer energy storage device into liquid compositions and: (1) applying a first liquid current collector composition above the surface to form a first current collector layer above the surface; (2) applying a first liquid electrode composition above the first current collector layer to form a first electrode layer above the first current collector layer; (3) applying a liquid electrically insulating composition above the first electrode layer to form an electrically insulating layer above the first electrode layer; (4) applying a second liquid electrode composition above the electrically insulating layer to form a second electrode layer above the electrically insulating layer; and (5) applying a second liquid current collector composition above the second electrode layer to form a second current collector layer above the second electrode layer.





Published:

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

- *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))*

27 February 2014

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 11321-P258WO	FOR FURTHER ACTION see Form PCT/ISA/220 as well as, where applicable, item 5 below.	
International application No. PCT/US2013/032394	International filing date (<i>day/month/year</i>) 15 March 2013	(Earliest) Priority Date (<i>day/month/year</i>) 15 March 2012
Applicant WILLIAM MARSH RICE UNIVERSITY		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.

It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

a. With regard to the language, the international search was carried out on the basis of:

- the international application in the language in which it was filed.
 a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

b. This international search report has been established taking into account the rectification of an obvious mistake authorized by or notified to this Authority under Rule 91 (Rule 43.6bis(a)).

c. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, see Box No. I.

2. Certain claims were found unsearchable (see Box No. II).

3. Unity of invention is lacking (see Box No. III).

4. With regard to the title,

- the text is approved as submitted by the applicant.
 the text has been established by this Authority to read as follows:

5. With regard to the abstract,

- the text is approved as submitted by the applicant.
 the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the drawings,

- a. the figure of the drawings to be published with the abstract is Figure No. 2
 as suggested by the applicant.
 as selected by this Authority, because the applicant failed to suggest a figure.
 as selected by this Authority, because this figure better characterizes the invention.
- b. none of the figures is to be published with the abstract.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/032394

<p>A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H01M 4/13 (2013.01) USPC - 429/231.95 According to International Patent Classification (IPC) or to both national classification and IPC</p>																																									
<p>B. FIELDS SEARCHED</p> <p>Minimum documentation searched (classification system followed by classification symbols) IPC(8) - H01M 4/13, 4/58, 2/16, 6/04 (2013.01) USPC - 429/231.95, 231.8, 188, 207, 246, 405</p> <p>Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched CPC - H01M 10/0525, 4/587, 2/1673 (2013.01)</p> <p>Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Orbit, Google Patents, ProQuest</p>																																									
<p>C. DOCUMENTS CONSIDERED TO BE RELEVANT</p> <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>EP 2 270 909 A1 (DUNLEAVY et al) 05 January 2011 (05.01.2011) entire document</td> <td>1-9, 11, 13-17, 20-21, 31-35, 41-53, 55-60, 63</td> </tr> <tr> <td>-----</td> <td></td> <td>-----</td> </tr> <tr> <td>Y</td> <td></td> <td>10, 12, 18-19, 22-30, 36-40, 54, 61-62</td> </tr> <tr> <td>Y</td> <td>US 2008/0138696 A1 (BARTLING) 12 June 2008 (12.06.2008) entire document</td> <td>10</td> </tr> <tr> <td>Y</td> <td>US 2010/0330425 A1 (LOPATIN et al) 30 December 2010 (30.12.2010) entire document</td> <td>12</td> </tr> <tr> <td>Y</td> <td>US 2012/0009331 A1 (KWON et al) 12 January 2012 (12.01.2012) entire document</td> <td>18-19</td> </tr> <tr> <td>Y</td> <td>US 2011/0165459 A1 (HALALAY et al) 07 July 2011 (07.07.2011) entire document</td> <td>22</td> </tr> <tr> <td>Y</td> <td>US 2008/0190841 A1 (PASCALY et al) 14 August 2008 (14.08.2008) entire document</td> <td>23</td> </tr> <tr> <td>Y</td> <td>US 2012/0015232 A1 (TESHIMA et al) 19 January 2012 (19.01.2012) entire document</td> <td>24-27</td> </tr> <tr> <td>Y</td> <td>US 2012/0045694 A1 (PARK et al) 23 February 2012 (23.02.2012) entire document</td> <td>28</td> </tr> <tr> <td>Y</td> <td>US 2012/0048729 A1 (MIKHAYLIK et al) 01 March 2012 (01.03.2012) entire document</td> <td>29</td> </tr> <tr> <td>Y</td> <td>US 2008/0090138 A1 (VU et al) 17 April 2008 (17.04.2008) entire document</td> <td>30, 54</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	EP 2 270 909 A1 (DUNLEAVY et al) 05 January 2011 (05.01.2011) entire document	1-9, 11, 13-17, 20-21, 31-35, 41-53, 55-60, 63	-----		-----	Y		10, 12, 18-19, 22-30, 36-40, 54, 61-62	Y	US 2008/0138696 A1 (BARTLING) 12 June 2008 (12.06.2008) entire document	10	Y	US 2010/0330425 A1 (LOPATIN et al) 30 December 2010 (30.12.2010) entire document	12	Y	US 2012/0009331 A1 (KWON et al) 12 January 2012 (12.01.2012) entire document	18-19	Y	US 2011/0165459 A1 (HALALAY et al) 07 July 2011 (07.07.2011) entire document	22	Y	US 2008/0190841 A1 (PASCALY et al) 14 August 2008 (14.08.2008) entire document	23	Y	US 2012/0015232 A1 (TESHIMA et al) 19 January 2012 (19.01.2012) entire document	24-27	Y	US 2012/0045694 A1 (PARK et al) 23 February 2012 (23.02.2012) entire document	28	Y	US 2012/0048729 A1 (MIKHAYLIK et al) 01 March 2012 (01.03.2012) entire document	29	Y	US 2008/0090138 A1 (VU et al) 17 April 2008 (17.04.2008) entire document	30, 54
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<p>Date of the actual completion of the international search</p> <p>30 December 2013</p>		<p>Date of mailing of the international search report</p> <p style="font-size: 1.5em; text-align: center;">10 JAN 2014</p>																																							
<p>Name and mailing address of the ISA/US</p> <p>Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201</p>		<p>Authorized officer:</p> <p style="text-align: center;">Blaine R. Copenheaver</p> <p>PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774</p>																																							

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2013/032394

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0070989 A1 (POZIN et al) 19 March 2009 (19.03.2009) entire document	36-38, 61-62
Y	US 2011/0256450 A1 (CAMPBELL et al) 20 October 2011 (20.10.2011) entire document	39-40
A	US 2011/0104571 A1 (ZHAMU et al) 05 May 2011 (05.05.2011) entire document	1-63
A	US 2011/0274850 A1 (YANG et al) 10 November 2011 (10.11.2011) entire document	1-63