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62/095,832 23 December 2014 (23.12.2014) US
- (71) **Applicant:** CAMBRIDGE DISPLAY TECHNOLOGY, LTD. [GB/GB]; Unit 12 Cardinal Park, Cardinal Way, Godmanchester, OT PE29 2XG (GB).
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- (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, 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.

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- 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))

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20 October 2016



WO 2016/102069 A3

(54) **Title:** ORGANIC FLOW CELL BATTERIES AND MATERIALS FOR USE IN SAME

(57) **Abstract:** The present invention relates to an organic flow cell battery having a material comprising an organic molecule that can be used as the electroactive redox material for both electrodes of the battery. By enabling two-electron processes both of the oxidation and reduction to occur in a single molecule, a total of 4-electron transitions is achieved, which allows the organic molecule to be used on both sides of the separator, reducing material costs and allowing the battery to be charge in either direction with equal ease.

INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2015/002607

A. CLASSIFICATION OF SUBJECT MATTER  
INV. H01M8/18 H01M8/20  
ADD.  
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  
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
EPO-Internal, INSPEC, COMPENDEX, EMBASE, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 10 2012 015176 A1 (UNIV BRAUNSCHWEIG TECH [DE]) 6 February 2014 (2014-02-06)	1-3
Y	paragraph [0009] - paragraph [0012]; claims 1-13	4-9
X	----- US 8 080 327 B1 (RASMUSSEN PAUL GEORGE [US]) 20 December 2011 (2011-12-20) cited in the application	1-3
Y	column 1, line 21 - column 3, line 4; figures 3,6-10 ----- -/--	4-9

Further documents are listed in the continuation of Box C.

See patent family annex.

\* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"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</p> <p>"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</p> <p>"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</p> <p>"&amp;" document member of the same patent family</p>
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Date of the actual completion of the international search  11 July 2016	Date of mailing of the international search report  08/09/2016
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Stachowiak, Olaf
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## INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2015/002607

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	ROESSLER A ET AL: "DIRECT ELECTROCHEMICAL REDUCTION OF INDIGO: PROCESS OPTIMIZATION AND SCALE-UP IN A FLOW CELL", JOURNAL OF APPLIED ELECTROCHEMISTRY, SPRINGER, DORDRECHT, NL, vol. 32, no. 6, 1 June 2002 (2002-06-01), pages 647-651, XP008013548, ISSN: 0021-891X, DOI: 10.1023/A:1020198116170	4-9
A	Scheme 1; page 647 - page 648; figure 1	1-3
A	HUSKINSON B ET AL: "A metal-free organic-inorganic aqueous flow battery", NATURE NATURE PUBLISHING GROUP UK, vol. 505, no. 7482, 9 January 2014 (2014-01-09), pages 195-198, XP002754835, ISSN: 0028-0836 cited in the application the whole document	1-9
Y	WO 2014/052682 A2 (HARVARD COLLEGE [US]) 3 April 2014 (2014-04-03) cited in the application	4-9
A	claims 1-15	1-3
Y	US 2014/370403 A1 (NARAYAN SRI [US] ET AL) 18 December 2014 (2014-12-18)	4-9
A	claims 6-33; figures 1-9	1-3

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/EP2015/002607

## 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:

see additional sheet

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 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.:  
  
1-9
  
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.

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-9(partially)

An organic flow cell battery having a material comprising an organic molecule that can be used as the electroactive redox material for both electrodes of the battery, wherein the organic molecule exhibits the first of the core units as specified in the table provided in claim 4.

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2-14. claims: 1-9(partially)

An organic flow cell battery having a material comprising an organic molecule that can be used as the electroactive redox material for both electrodes of the battery, wherein the organic molecule exhibits one of the core units 2-14 as specified in the table provided in claim 4.

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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/EP2015/002607
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102012015176 A1	06-02-2014	NONE	
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US 8080327	B1	20-12-2011	NONE
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WO 2014052682	A2	03-04-2014	
		AU 2013323439 A1	30-04-2015
		CA 2885929 A1	03-04-2014
		CN 105308785 A	03-02-2016
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		US 2015243991 A1	27-08-2015
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		WO 2014052682 A2	03-04-2014
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US 2014370403	A1	18-12-2014	
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