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(72) Inventor; and

Published:

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— 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:
11 August 2011

(54) Title: METHOD AND MEANS FOR A HIGH POWER SOLAR CELL

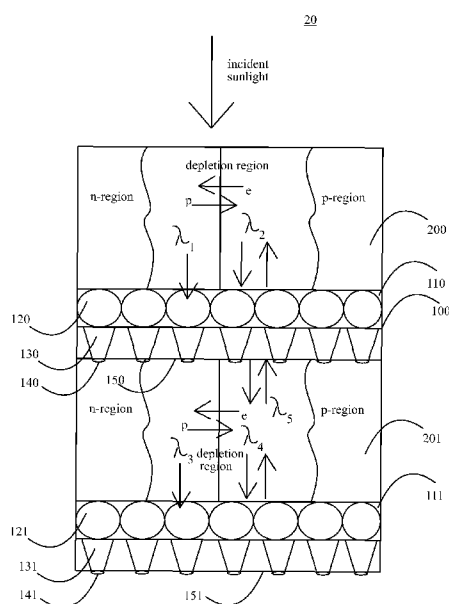


FIG. 2A.

(57) Abstract: The invention relates to methods and means for improving the power generated, and thus efficiency of solar cells (20, 30). The best mode of the invention at present is considered to be a double or triple junction tandem solar cell (20, 30) that has one or two photon filters (100, 101) of the invention in between the solar cell layers (200, 201, 202, 203), respectively. The photon filter (100, 101, 102) is arranged to reflect photons with wavelength shorter than λ_x and arranged to be transparent to photons of wavelength longer than λ_x by focussing the said lower energy photons out of small area apertures (140, 141) on the other side of the photon filter (100, 101, 102) and arranging the other side of the photon filter (100, 101, 102) to reflect (150, 151) at least some of the said photons of wavelength longer than λ_x . By using the photon filters (100, 101, and 102) of the invention in between the solar cell layers (200, 201, 202, and 203), photons can be trapped between filters to solar cell layers at an energy at which the quantum efficiency (QE) of the solar cell layer is the best.

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A. CLASSIFICATION OF SUBJECT MATTER
INV. H01L31/0232 H01L31/072 G02B6/00
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)
H01L G02B

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 practical, search terms used)

EPO-Internal, INSPEC, 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	US 5 021 100 A (ISHIHARA TAKASHI [JP] ET AL) 4 June 1991 (1991-06-04)	12,14,15
A	column 2, line 40 - line 56; figures 1-3 column 3, line 18 - line 41 column 4, line 26 - line 44	1-9
A	PLATZ R ET AL: "Improved micromorph tandem cell performance through enhanced top cell currents", CONFERENCE RECORD OF THE 26TH IEEE PHOTOVOLTAIC SPECIALISTS CONFERENCE 19970929; 19970929 - 19971003 NEW YORK, NY : IEEE, US LNKD-DOI:10.1109/PVSC.1997.654183, 29 September 1997 (1997-09-29), pages 691-694, XP010267879, ISBN: 978-0-7803-3767-1 the whole document	1-9
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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 document 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
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- "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

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2008/145176 A1 (CONSIGLIO NAZ DELLE RICERCHE I [IT]; TORMEN MASSIMO [IT]; INGANAS OLLE) 4 December 2008 (2008-12-04) page 6, line 8 - page 7, line 13; figure 4 -----	1-9
A	JP 2003 101059 A (SHARP KK) 4 April 2003 (2003-04-04) abstract; figures 1,2 -----	1-9
A	US 5 220 462 A (FELDMAN JR KARL T [US]) 15 June 1993 (1993-06-15) the whole document -----	1-9
A	JP 9 162435 A (TOPPAN PRINTING CO LTD) 20 June 1997 (1997-06-20) abstract -----	1-9
X	WANLASS M W: "HIGH-PERFORMANCE CONCENTRATOR TANDEM SOLAR CELLS BASED ON IR- SENSITIVE BOTTOM CELLS", SOLAR CELLS, ELSEVIER SEQUOIA.S.A. LAUSANNE, CH, vol. 30, no. 1 / 04, 1 May 1991 (1991-05-01), pages 363-371, XP000243418, DOI: DOI:10.1016/0379-6787(91)90069-2 page 366 - page 367; figures 2-6 -----	12-15
X	JP 60 111478 A (TOSHIBA KK) 17 June 1985 (1985-06-17) the whole document -----	12,13
X	US 2006/043517 A1 (SASAKI TOSHIKI [JP] ET AL) 2 March 2006 (2006-03-02)	20
A	paragraphs [0033] - [0037], [0043], [0081] - [0084]; figures 10,17-19,21-28; example 1 -----	18,19
X	US 5 039 354 A (NAKAGAWA KATSUMI [JP]) 13 August 1991 (1991-08-13)	20
A	column 6, line 60 - column 9, line 46; figures 1,2,4 -----	12,18,19
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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/057888

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p> DATABASE WPI Section Ch, Week 197735 Thomson Scientific, London, GB; Class L03, AN 1977-61739Y XP002637931, "Sealed silver oxide-cadmium alkaline secondary battery - used for wrist watches, and charged by solar cell and thermoelectric element", -& JP 52 084435 A (SUWA SEIKOSHA KK) 14 July 1977 (1977-07-14) abstract ----- </p>	21,22

INTERNATIONAL SEARCH REPORT

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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.: 10, 11, 16, 17
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:
see FURTHER INFORMATION sheet PCT/ISA/210

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.:

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

A tandem solar cell with a photon filter between the two cells, the photon filter reflecting on its first side part of the spectrum back in the first cell while focusing the rest of the spectrum on small aperture on its second side for trapping light in the second cell.

2. claims: 12-15

A tandem cell with a first photon filter, an AR layer and a second photon filter located between the two cells.

3. claims: 18, 19

A tandem cell with its second cell having a lower refractive index than the first one at photon energies higher than the bandgap of the first cell.

4. claim: 20

A tandem cell where one of the cells has its QE vs wavelength function and its refractive index vs wavelength function reaching a peak at the same wavelength

5. claims: 21, 22

A portable electronic device with a solar cell and a piezoelectric crystal for generating electricity from mechanical movement.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 10, 11, 16, 17

The subject-matter of independent claim 10 and dependent claim 11 is defined as a result to be achieved. The technical features needed to achieve this result are not given in the claims so that a meaningful search covering the possible solutions is not possible. The subject-matter of independent claim 16 and dependent claim 17 is rendered unclear by the wordings "unidirectional photon filter". These wordings are vague and broad, and when interpreted in the light of the description also constitute a result to be achieved so that a meaningful search is not possible.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.2), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/EP2010/057888

Patent document cited in search report	A	Publication date	Patent family member(s)	Publication date
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