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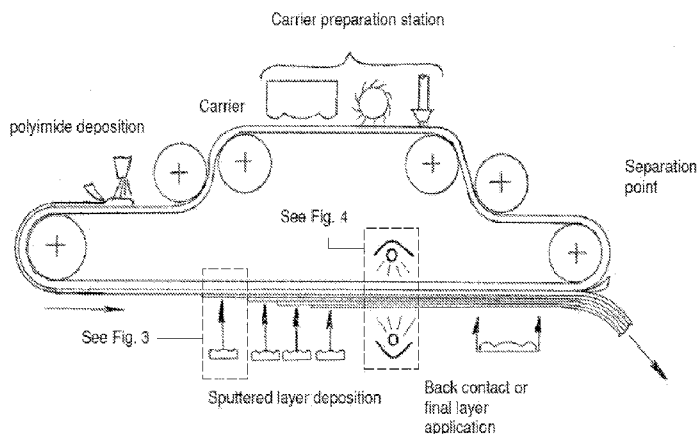


Fig. 2

(57) Abstract: A photovoltaic cell includes a polymer window and at least one active semiconductor layer that is conditioned using a cadmium chloride treatment process. The photovoltaic cell is heated, during the cadmium chloride treatment process by a rapid thermal activation process to maintain polymer transparency. A method of producing a photovoltaic cell using the rapid thermal activation process and an apparatus to conduct rapid thermal activation processing are also disclosed.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 11/00814

A. CLASSIFICATION OF SUBJECT MATTER IPC(8) - H01L 31/00 (2011.01) USPC - 136/246 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) IPC(8)- H01L 31/00 (2011.01); USPC- 136/246 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched USPC- 136/251, 255, 256, 258, 259, 260, 264; 257/42, 53, 66, 433, 434, 461, 464; 438/64, 84, 86, 87, 93, 94, 95, 96, 97, 98; Patents and NPL (classification, keyword; search terms below) Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) PubWest (US Pat, PgPub, EPO, JPO), GoogleScholar (PL, NPL), FreePatentsOnline (US Pat, PgPub, EPO, JPO, WIPO, NPL); search terms: superstrate, polymer, plastic, polyimide, foil, film, substrate, optical, light, transparency, CdCl ₂ , cadmium, chloride, maintain, retain, constant, expose, deposit, vapor, vapour, sputter, PVD, CVD, AVD		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0223551 A1 (REDDY et al.) 10 September 2009 (10.09.2009), Fig. 2; para [0014], [0017], [0024], [0030], [0034], [0035], [0045]-[0048], [0053]	1-12, 39
Y	US 2002/0157703 A1 (NAKAYAMA et al.) 31 October 2002 (31.10.2002), Fig. 5; [0014], [0044], [0053], [0056]-[0058], [0066], [0085]-[0088], [0129], [0143], [0144]	1-12, 39
Y	US 2007/0157962 A1 (GRONET) 12 July 2007 (12.07.2007), para [0011], [0022], [0039], [0048], [0081], [0086], [0139], [0163], [0234]	9-11
Y	EP 2 138 608 A1 (VAN NEER et al.) 30 December 2009 (30.12.2009), para [0009]-[0045]	1-12, 39
Y	US 2007/0235074 A1 (HENLEY et al.) 11 October 2007 (11.10.2007), para [0047]-[0126]	1-12, 39
Y	US 6,548,751 B2 (SVERDRUP, JR, et al.) 15 April 2003 (15.04.2003), Fig. 4; col 3-14	1-12, 39
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/>		
* 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 31 October 2011 (31.10.2011)		Date of mailing of the international search report 17 NOV 2011
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201		Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 11/00814

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 I: claims 1-12 and 39
- Group II: claims 13-36, 40, and 41
- Group III: claims 37 and 38

---see extra 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 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.:
1-12 and 39

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/US 11/00814

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

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: claims 1-12 and 39: drawn to a photovoltaic cell comprising a polymer-based superstrate layer having an optical transparency that is substantially maintained during a CdCl₂ exposure.

Group II: claims 13-36, 40, and 41: drawn to a method for forming photovoltaic cells including polymer sheet dispensing, semiconductor layer formation, and exposure to a rapid thermal activation process.

Group III: claims 37 and 38, drawn to a apparatus for forming photovoltaic cells including an application station, sputtering guns configured to form a semiconductor layer, a rapid thermal activation station, and a detachment station.

The inventions listed as Groups I through III do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Groups II-III do not require a the specific semitransparent photovoltaic cell with CdCl₂ exposure, as required by group I.

Groups I and III do not require the the specific photovoltaic cell forming method including roll-to-roll manufacturing process, as required by group II.

Groups I-II do not require the specific photovoltaic cell forming apparatus or apparatus including rapid sputtering guns or a detachment station, as required by group II.

The technical features shared by groups I-III is a photovoltaic cell having a polymer-based superstrate/window layer on a carrier layer. However, such a a photovoltaic cell was well known at the time the invention was made as demonstrated by US 6,548,751 B2, entitled "Thin film flexible solar cell" to Sverdrup Jr. et al., published 15 April 2003 (15.04.2003), see FIG. 4, col. 5, ln. 63 to col. 6, ln. 18 (superstrate layer 410 ,comprising a transparent, substantially flexible plastic or polymer such as tefzel, and further comprising bus bar network 405 , transparent conductive oxide (TCO) layer 425 , window (n) layer 425 , absorption (p) layer 430 , back contact layer 435 , encapsulation layer 440 and polymer backing 445). Thus, the photovoltaic cell having a polymer-based superstrate/window layer on a carrier layer cannot be considered a special technical feature that would otherwise unify the groups.

An additional feature shared by groups II and III is the formation of a photovoltaic cell by a rapid thermal activation process. However, a rapid thermal activation was well known at the time the invention was made as demonstrated by US 2007/0235074 A1, entitled "METHOD AND STRUCTURE FOR FABRICATING SOLAR CELLS USING A LAYER TRANSFER PROCESS" to Henley et al., published 11 October 2007 (11.10.2007), see para. [0027], [0156], [0158] (rapid thermal process/station). Thus, a rapid thermal activation process for forming said cells cannot be considered a special technical feature that would otherwise unify the groups.

Groups I through III therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.