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(54) Title: LIGHT SCATTERING ARTICLES BY ABRASION AND ETCH

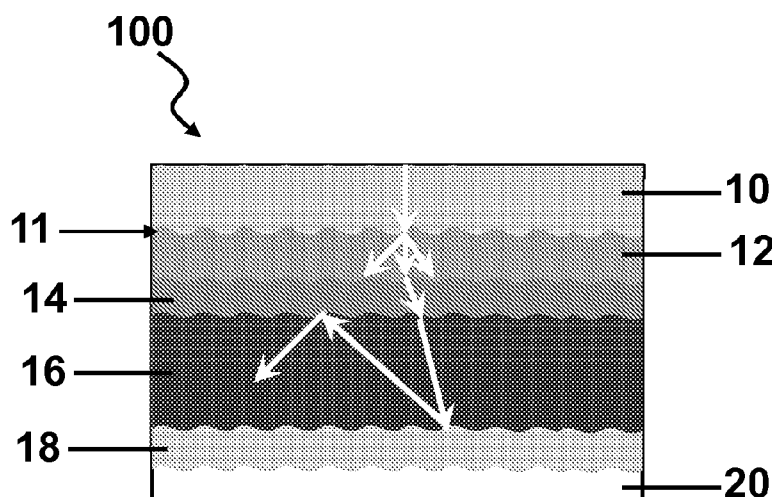


Figure 1

(57) Abstract: A method comprises providing a glass substrate having a surface; spraying the surface with a slurry comprising abrasive particles and water to form an abraded surface; and etching the abraded surface to form a textured glass substrate. The textured glass substrate can be used in photovoltaic cells. A photovoltaic device comprising a light scattering article comprises a glass substrate having a textured surface, wherein the surface comprises smooth craters having an average width of from 1 to 15 microns; a conductive material adjacent to the surface; and an active photovoltaic medium adjacent to the conductive material.

LIGHT SCATTERING ARTICLES BY ABRASION AND ETCH

[0001] This application claims the benefit of priority under 35 U.S.C. § 119 of U.S. Provisional Application Serial No. 61/490306 filed May 26, 2011 the content of which is relied upon and incorporated herein by reference in its entirety.

BACKGROUND**Field**

[0002] Embodiments relate generally to light scattering articles and more particularly to light scattering inorganic articles having textured surfaces and abrasive methods of making the textured surfaces useful for, for example, photovoltaic cells.

Technical Background

[0003] Thin film amorphous/microcrystalline silicon (Si-tandem) type photovoltaic cells are based on the use of a glass sheet onto which an assembly of thin films (TCO, amorphous silicon, crystalline silicon and anti reflective coating) are deposited. In Si-tandem PV solar cells, it is advantageous to obtain a high usage of incident light, which can be brought partly by the glass superstrate. Moreover, the texture of the TCO can have a direct and/or indirect impact on the overall cell quantum efficiency (Q.E.) yield. The glass superstrate, when textured, can be used to orient the texture of the TCO.

[0004] WO 2009/026648 A1 (CSG Solar AG) describes abrasion and etch texturing of glass where the initial abrasion is done by sandblasting. It seems that the preferred method is dry sandblasting, and that wet sandblasting is added as a possible

alternative. Orbital lapping is also mentioned as a possible texturing technique.

[0005] It would be advantageous to have light scattering textured glass substrates wherein abrasion and etching create a textured surface on the substrate. Further, it would be advantageous to create a texture on the surface of a glass substrate useful for Si-tandem photovoltaic cells.

SUMMARY

[0006] Light scattering articles and methods of making the light scattering articles, as described herein, address one or more of the above-mentioned disadvantages of conventional light scattering articles and/or methods and may provide one or more of the following advantages: simplicity and potential high throughput in manufacturing, flexibility in the final properties such as haze and diffusion, and the potential to texture only parts of the initial substrate by masking select areas of the glass substrate.

[0007] One embodiment is a method comprising providing a glass substrate having a surface, spraying the surface with a slurry comprising abrasive particles and water to form an abraded surface, and etching the abraded surface to form a textured glass substrate.

[0008] Another embodiment is a photovoltaic device comprising a light scattering article comprising a glass substrate having a textured surface, wherein the surface comprises smooth craters having an average width of from 1 to 10 microns; a conductive material adjacent to the particles; and an active photovoltaic medium adjacent to the conductive material.

[0009] Additional features and advantages of the invention will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from

the description or recognized by practicing the invention as described in the written description and claims hereof, as well as the appended drawings.

[0010] It is to be understood that both the foregoing general description and the following detailed description are merely exemplary of the invention, and are intended to provide an overview or framework for understanding the nature and character of the invention as it is claimed.

[0011] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate one or more embodiment(s) of the invention and together with the description serve to explain the principles and operation of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The invention can be understood from the following detailed description either alone or together with the accompanying drawing figures.

[0013] **Figure 1** is a schematic diagram of features of a Si-tandem PV solar cell, according to one embodiment.

[0014] **Figure 2** is an optical photo of the sandblasting step in an exemplary method.

[0015] **Figure 3** is a flow chart of an exemplary method.

[0016] **Figures 4A** and **4B** are scanning electron microscope (SEM) images of an exemplary abraded surface obtained after the sandblasting step.

[0017] **Figures 5A** and **5B** are SEM images of the surface obtained after sandblasting and etching steps, according to one embodiment.

[0018] **Figure 6** is a graph showing diffuse transmittance after exemplary sandblasting and etching for four typical textures:

ultra-high, high, medium and low haze textures (from top to bottom).

[0019] Figure 7 is a graph showing angular scattering for an exemplary medium haze sandblasted and etched glass substrate.

[0020] Figure 8 is a graph showing angular scattering for an exemplary high haze sandblasted and etched glass substrate.

DETAILED DESCRIPTION

[0021] Reference will now be made in detail to various embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0022] As used herein, the term "substrate" can be used to describe either a substrate or a superstrate depending on the configuration of the photovoltaic cell. For example, the substrate is a superstrate, if when assembled into a photovoltaic cell, it is on the light incident side of a photovoltaic cell. The superstrate can provide protection for the photovoltaic materials from impact and environmental degradation while allowing transmission of the appropriate wavelengths of the solar spectrum. Further, multiple photovoltaic cells can be arranged into a photovoltaic module.

[0023] As used herein, the term "adjacent" can be defined as being in close proximity. Adjacent structures may or may not be in physical contact with each other. Adjacent structures can have other layers and/or structures disposed between them.

[0024] One embodiment, as shown by the schematic diagram in **Figure 1**, are features **100** of a photovoltaic device, for example, a Si-tandem PV solar cell comprising a light scattering article comprising a glass substrate **10** having a textured surface **11**, wherein the surface comprises smooth

craters having an average width of from 1 to 15 microns; a conductive material **12** adjacent to the surface; and an active photovoltaic medium adjacent to the conductive material. In this embodiment, the active photovoltaic medium is a Si-tandem (amorphous silicon **14**, crystalline silicon **16**) medium. The smooth craters can be random in size and some craters can be smaller or larger than 1 to 15 microns.

[0025] In one embodiment, the conductive material is a transparent conductive film. The transparent conductive film, for example, a transparent conductive oxide (TCO) can comprise a textured surface. The texture of the TCO can be conformal to the texture of the textured glass substrate. The active photovoltaic medium can be in physical contact with the transparent conductive film.

[0026] In one embodiment, the device further comprises a counter electrode **18** in physical contact with the active photovoltaic medium and located on an opposite surface of the active photovoltaic medium as the conductive material. The device can further comprise a back reflector **20** adjacent to the counter electrode. The texturing from the textured glass substrate can be conformal throughout all of the layers. The white arrows show light scattering through the textured layers of the photovoltaic device.

[0027] The TCO, in one embodiment, is from greater than 0 to 2 microns in thickness, for example, 0.5 microns to 1.5 microns, for example, 0.5 microns to 1 micron in thickness. The amorphous silicon, in one embodiment, is greater than 0 to 0.5 microns, for example, 0.1 to 0.2 microns in thickness. The crystalline silicon, in one embodiment, is 3 microns or less in thickness, for example, from greater than 0 to 2 microns.

[0028] One embodiment is a method comprising providing a glass substrate having a surface, spraying the surface with a slurry

comprising abrasive particles and water to form an abraded surface, and etching the abraded surface to form a textured glass substrate.

[0029] Spraying, according to one embodiment, comprises propelling the slurry with compressed air, hydrodynamic pressure, or a combination thereof.

[0030] Spraying can comprise using an 8 mm diameter nozzle, a liquid flowrate of 10 liters per minute, and a compressed air pressure of from 2 to 4 bars to spray the slurry. The distance between the nozzle and the surface, in one embodiment, is from 50 mm to 150 mm. The spraying can be done by spraying the slurry from the nozzle at an angle normal to the surface. One or more nozzles can be translated across the surface of the glass substrate.

[0031] In one embodiment, the abrasive particles have an average diameter of from 1 micron to 20 microns, for example, 1 to 15 microns, for example, 1 to 10 microns. In one embodiment, the abrasive particles have a mesh size of from 400 to 1200. In one embodiment, the abrasive particles have a 600 mesh size, a particle size distribution of from 5 microns to 20 microns, and a median particle size of 10 microns. The abrasive particles can comprise alumina, silicon carbide, or a combination thereof, or are alumina. Other types of particles can be used as abrasive particles, for example, any material which is capable of removing glass from the surface of the glass substrate.

[0032] The slurry can comprise from 20 to 40 weight percent alumina in water. In some embodiments, the glass substrate is a sodalime glass, a specialty glass, fused silica, an alkali-free glass, or a combination thereof.

[0033] According to one embodiment, etching comprises etching the abraded surface with an etching solution comprising HF and HCl. The solution can be a 1:1:20 solution of HF:HCl:H₂O. In one embodiment, the etching comprises etching the abraded surface for from 5 to 15 minutes. The method can further comprise cleaning the textured glass substrate after the etching. The etching could be performed by either dipping (in a bath with etching solution) and/or by spraying (with similar or same etching solution).

[0034] The method, according to one embodiment, further comprises masking select areas of the glass substrate prior to the spraying. Masking techniques as known in the art can be used.

[0035] According to one embodiment, the substrate is planar. In one embodiment, the glass substrate is transparent.

[0036] Photovoltaic devices can comprise the textured glass substrate made according to the described methods.

[0037] **Figure 3** is a flow chart of an exemplary method **300**. First, a glass sheet is cut to size **28**, the sheet is then sand blasted **30**, the sand blasted sheet is then rinsed **32**, the sheet is then etched **34**, for example, by immersion in a bath or spray of etching solution, the etched sheet is then rinsed and dried **36**, the edges of the sheet are then finished **38**, and a PV cell is then deposited on the sheet **40**.

[0038] The texture created on the glass superstrate is advantageously in a specific range of characteristic sizes and shapes in order to provide cell efficiency improvement without causing detrimental effects (ex. electrical shunts). A desired type of texture is a smooth crater, with a characteristic size in the micrometer range (greater than 0 to 15 μm , for example, 1 to 10 μm). This can be obtained by a first step of sandblasting which removes glass chips, leaving

a surface with sharp angles. The second step is acid etching, which preferentially starts on the edges and rounds them to lead to a smoother pattern.

[0039] In one embodiment, two surface treatments are used to texture the surface of an initial sheet of glass. This dual surface treatment may provide a texture that induces an improvement of the solar cell efficiency yield. The first surface treatment comprises media blasting the glass surface with a stream of fine abrasive particles (mixed in a slurry with water and propelled with compressed air). This slurry enables using finer abrasive particles than with air only and also produces fewer fractures on the surface of the glass substrate (the water is possibly acting as a damping medium on the impacting particles).

[0040] The second surface treatment is an acid etching step that partly modifies the texture obtained after the first step and restores the glass surface strength after media blasting, which causes micro cracks in the glass surface. The result is producing a highly diffusive surface while maintaining the total transmittance. This may allow improvement of light usage by decreasing the amount of reflected rays. Finally, the shape of the texture is believed to favorably orient the texture of the transparent conductive oxide deposited on the glass surface.

[0041] Several different types of glass substrates were tested with the sandblasting-etching method as described herein for glass texturing for Si-tandem PV solar cells: EagleXG™, HPFS® fused silica, soda-lime, specialty glass for CdTe solar cells, etc. Due to the nature of mechanical abrading dependence on glass surface strength, textures made on some specialty high surface strength glasses show features that could not be made on traditional glasses such as soda-lime. These features are

particularly favorable for light trapping and suitable for the growth of TCO/silicon layers.

[0042] In one embodiment, the slurry comprises alumina particles with a fine mesh (#600, corresponding to 5 to 20 μm particle size, with a median size at 10 μm). Alumina is used for its hardness. Fine particle distribution is advantageous to create small chips on the glass. Larger size particles result in lower improvement of the cell efficiency. The load of the solution is, in one embodiment, between 20 and 40 % by weight of alumina in water.

[0043] **Figure 2** is an optical photo of features **200** of the spraying, for example, sandblasting step in an exemplary method. For spraying, for example, for an 8 mm diameter nozzle **22**, the liquid flowrate is 10 liters per minute, and the air pressure is 2 to 4 bars. The distance between the nozzle and the surface of the glass substrate **24**, in this example, may range from 50 to 150 mm; this parameter may have a large impact on the resulting texture of the abraded surface. The glass substrate, in this example, is 2 by 6 inches. The glass carrier **26** can be moved horizontally or vertically at a controlled and adjustable rate. The impinging jet is directed normal to the surface of the glass substrate, the angle having a moderate incidence on the resulting texture of the abraded surface. Spraying time influences the surface fraction where abrasive impacts (craters) are created. After full coverage is reached, matter continues to be removed and seems to reproduce the same surface pattern. In a continuous process, the glass substrate is laid onto a carrier above which several nozzles are travelling back and forth to cover the full surface and provide a good homogeneity of the treatment. The time expected for the treatment of a Gen 5 sheet is expected to be 5 minutes on larger size equipment.

[0044] Figures 4A and 4B are scanning electron microscope (SEM) images of an exemplary abraded surface obtained after the sandblasting step. **Figure 4A** is a top down view and **Figure 4B** is a cross sectional view.

[0045] Samples were etched after the sandblasting step to partly modify the texture obtained after the first step and to restore the glass surface strength. This step is needed after the first one since media blasting causes micro cracks in the glass surface. The etching solution, in one embodiment, comprises a combination of HF and HCl. The etching solution can be made for the specific glass types used. Depending on glass type, various etching time is needed (ex. 1:1:20 solution of HF:HCl:H₂O requires 5-15 minutes of etching for display quality glass such as EagleXG™). All samples were rinsed (cleaned) after the etching step.

[0046] Figures 5A and 5B are SEM images of the surface obtained after sandblasting and etching steps in one embodiment. **Figure 5A** is a top down view and **Figure 5B** is a cross sectional view.

[0047] Figure 6 is a graph showing diffuse transmittance after sandblasting and etching for four typical textures: ultra-high, high, medium and low haze textures (from top to bottom).

[0048] Figure 7 is a graph showing angular scattering for an exemplary medium haze sandblasted and etched glass substrate.

[0049] Figure 8 is a graph showing angular scattering for an exemplary high haze sandblasted and etched glass substrate.

[0050] It will be apparent to those skilled in the art that various modifications and variations can be made to the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this

invention provided they come within the scope of the appended claims and their equivalents.

CLAIMS

What is claimed is:

1. A method comprising
 providing a glass substrate having a surface;
 spraying the surface with a slurry comprising
 abrasive particles and water to form an abraded surface;
 and
 etching the abraded surface to form a textured glass
 substrate.
2. The method according to claim 1, wherein the spraying
comprises propelling the slurry with compressed air,
hydrodynamic pressure, or a combination thereof.
3. The method according to claim 2, wherein the spraying
comprises using an 8 mm diameter nozzle, a liquid flowrate
of 10 liters per minute, and a compressed air pressure of
from 2 to 4 bars to spray the slurry.
4. The method according to claim 3, wherein the distance
between the nozzle and the surface is from 50 mm to 150 mm.
5. The method according to claim 4, wherein the spraying
comprises spraying the slurry from the nozzle at an angle
normal to the surface.
6. The method accord to claim 2, wherein the spraying
comprises translating one or more nozzles across the surface
of the glass substrate.

7. The method according to claim 1, wherein the abrasive particles have an average diameter of from 1 micron to 20 microns.

8. The method according to claim 7, wherein the abrasive particles have a mesh size of from 400 to 1200.

9. The method according to claim 1, wherein the abrasive particles have a 600 mesh size, a particle size distribution of from 5 microns to 20 microns, and a median particle size of 10 microns.

10. The method according to claim 1, wherein the abrasive particles comprise alumina, silicon carbide, or a combination thereof.

11. The method according to claim 10, wherein the slurry comprises from 20 to 40 weight percent alumina in water.

12. The method according to claim 1, wherein the glass substrate is a sodalime glass, a specialty glass, fused silica, an alkali-free glass, or a combination thereof.

13. The method according to claim 1, wherein the etching comprises etching the abraded surface with an etching solution comprising HF and HCl.

14. The method according to claim 13, wherein the solution is a 1:1:20 solution of HF:HCl:H₂O.

15. The method according to claim 13, wherein the etching comprises etching the abraded surface for from 5 to 15 minutes.

16. The method according to claim 1, further comprising cleaning the textured glass substrate after the etching.

17. The method according to claim 1, further comprising masking select areas of the glass substrate prior to the spraying.

18. A photovoltaic device comprising the textured glass substrate made according to claim 1.

19. A photovoltaic device comprising a light scattering article comprising a glass substrate having a textured surface, wherein the surface comprises smooth craters having an average width of from 1 to 15 microns; a conductive material adjacent to the particles; and an active photovoltaic medium adjacent to the conductive material.

20. The device according to claim 19, wherein the conductive material is a transparent conductive film.

21. The device according to claim 20, wherein the transparent conductive film comprises a textured surface.

22. The device according to claim 19, wherein the active photovoltaic medium is in physical contact with the transparent conductive film.

23. The device according to claim 19, further comprising a counter electrode in physical contact with the active photovoltaic medium and located on an opposite surface of the active photovoltaic medium as the conductive material.

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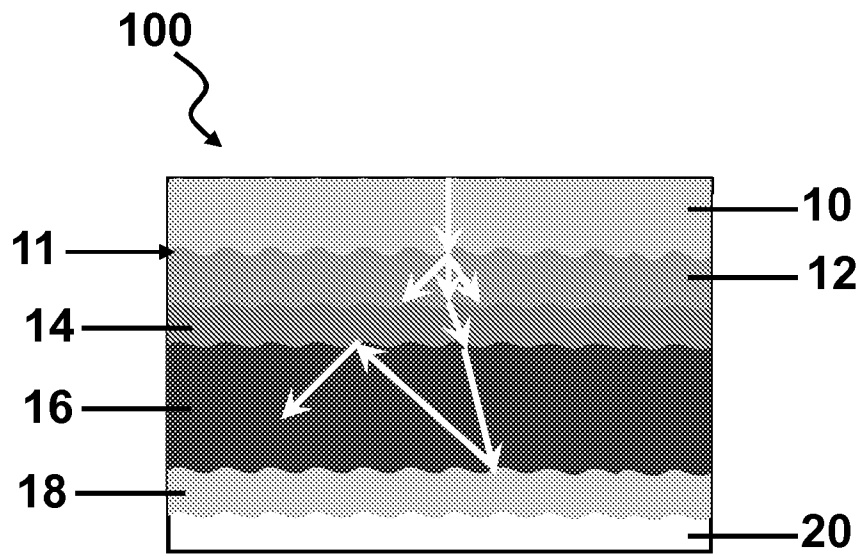


Figure 1

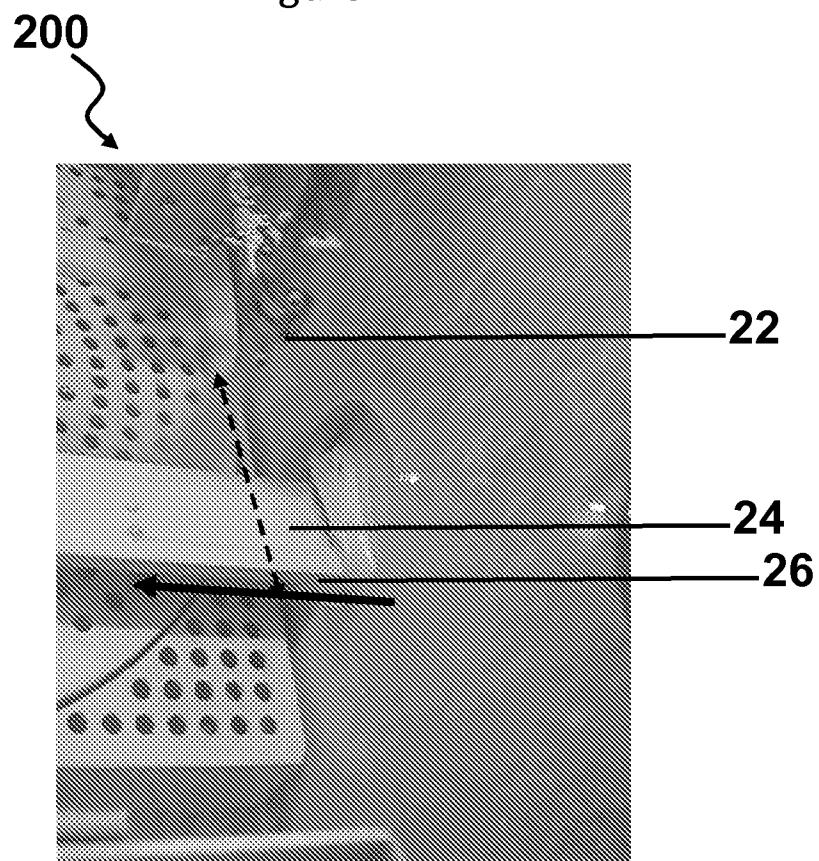


Figure 2

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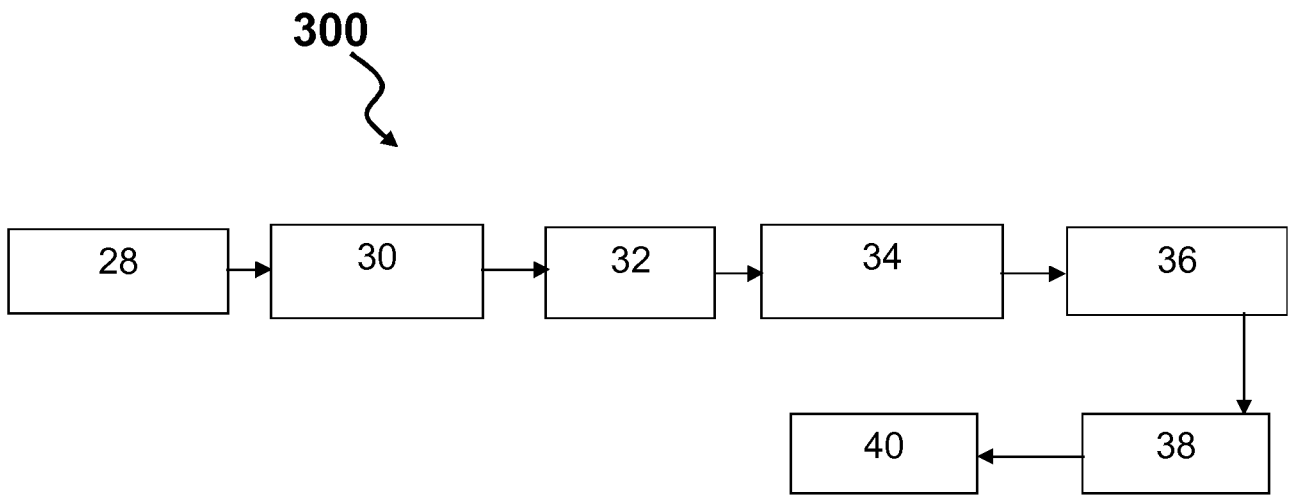
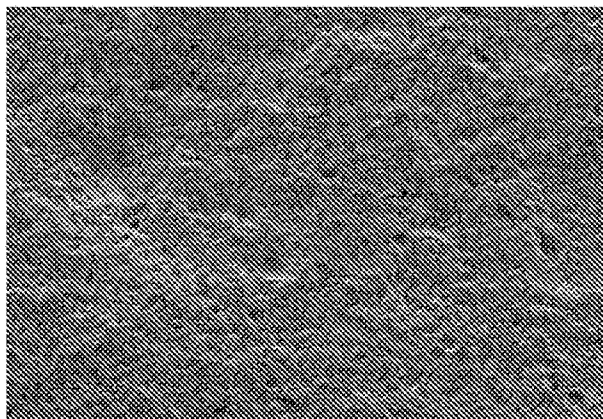
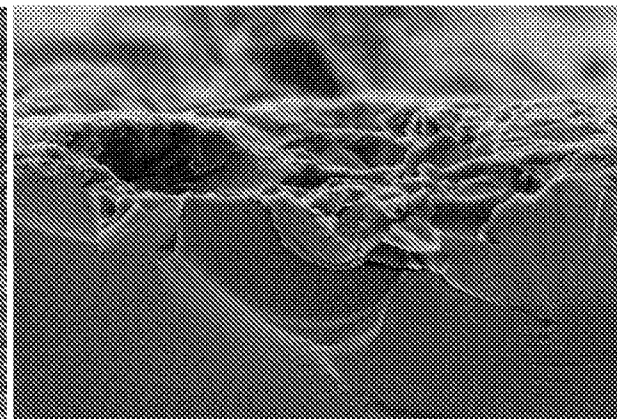


Figure 3



20 microns

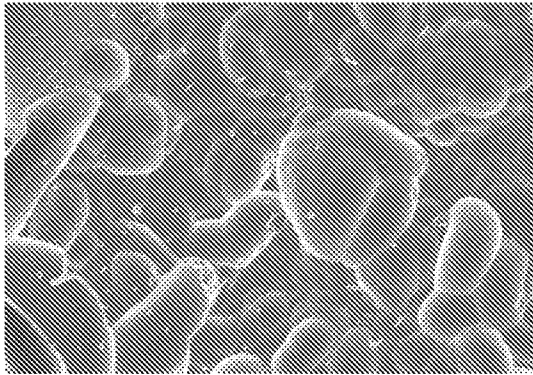
Figure 4A



2 microns

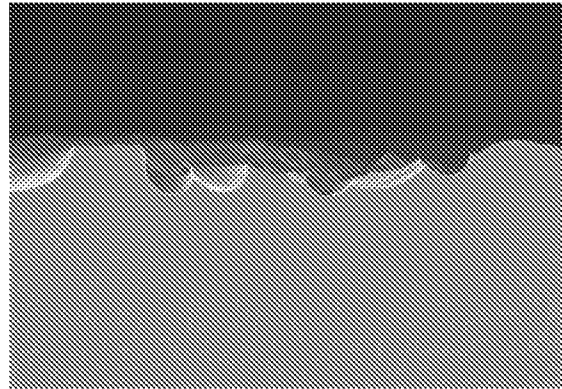
Figure 4B

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2 microns

Figure 5A




2 microns

Figure 5B

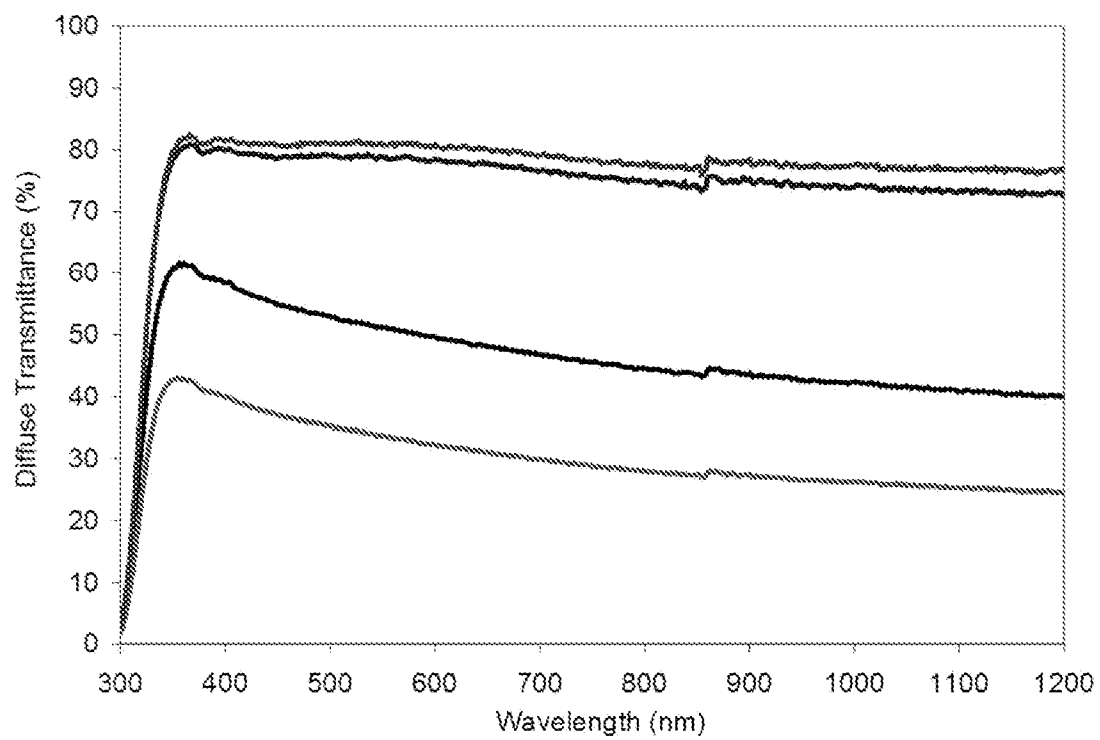


Figure 6

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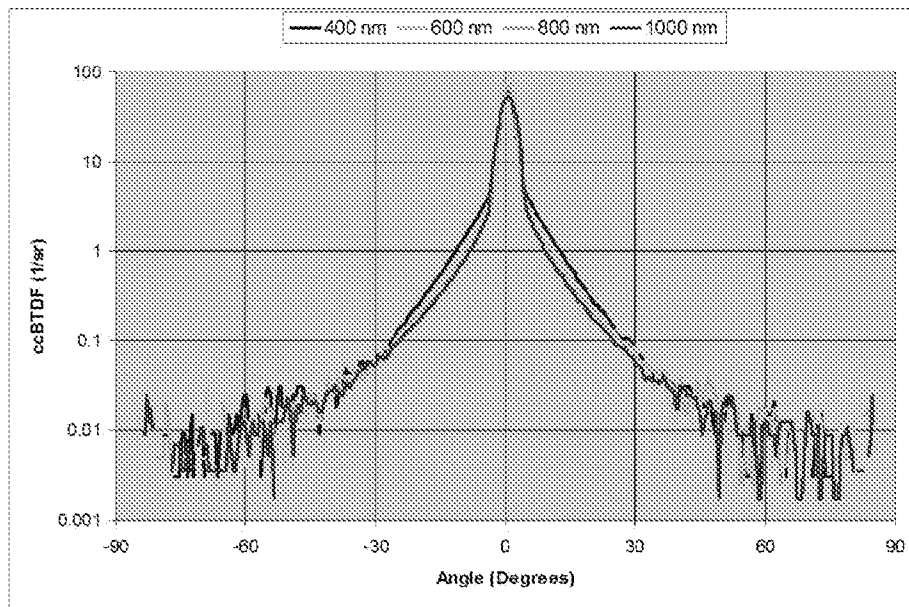


Figure 7

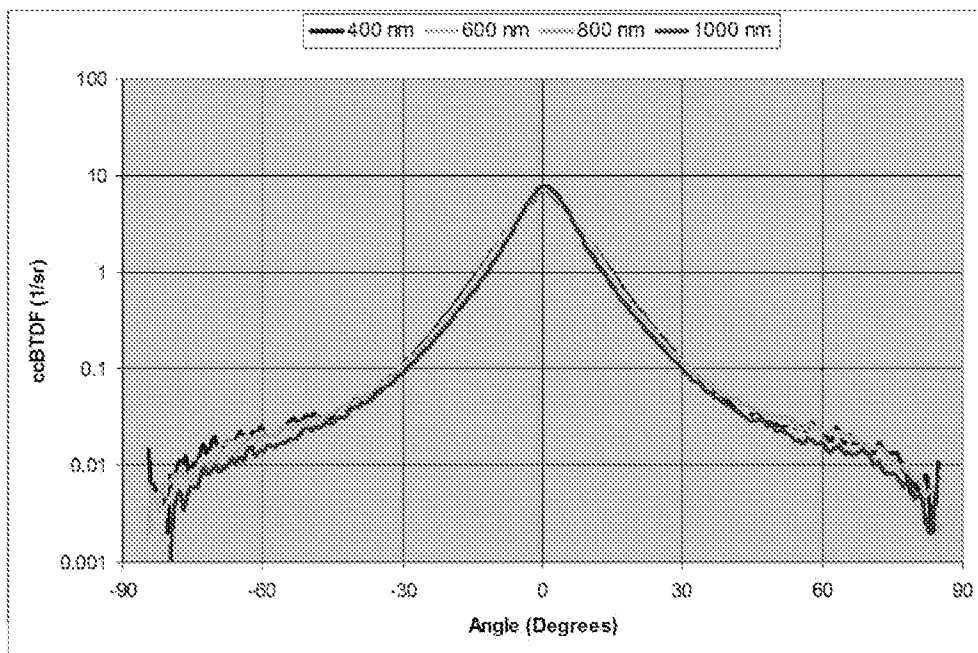


Figure 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/039233

A. CLASSIFICATION OF SUBJECT MATTER
INV. C03C15/00 C03C19/00 C09K3/14 B24C1/06 H01L31/0236
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)
C03C C09K B24C G02B H01L B24B

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, 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	WO 2009/026648 A1 (CSG SOLAR AG [DE]; YOUNG TREVOR LINDSAY [AU]) 5 March 2009 (2009-03-05) cited in the application page 1, lines 8-10, 21-31, 34-35 page 2, lines 1-4, 21-22 -----	1-23
X	DATABASE WPI Week 200331 Thomson Scientific, London, GB; AN 2003-321790 XP002681462, -& JP 2003 069059 A (KYOCERA CORP) 7 March 2003 (2003-03-07) abstract paragraphs [0009], [0026] ----- -/-	1-23

☒ 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)

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"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

8 August 2012

Date of mailing of the international search report

17/08/2012

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Fax: (+31-70) 340-3016

Authorized officer

Flügel, Alexander

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/039233

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DATABASE WPI Week 199920 Thomson Scientific, London, GB; AN 1999-239379 XP002681463, -& JP 11 068131 A (CITIZEN WATCH CO LTD) 9 March 1999 (1999-03-09) abstract -----	1-23
X	DATABASE WPI Week 201059 Thomson Scientific, London, GB; AN 2010-K90597 XP002681464, -& KR 2010 0097893 A (TG SOLAR CORP) 6 September 2010 (2010-09-06) abstract paragraphs [0033], [0039], [0040] -----	1-23
X	GB 683 596 A (RAULAND CORP) 3 December 1952 (1952-12-03)	1
A	page 2, lines 41-44, 70-73 -----	2-23
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/039233

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/039233

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.: 7-9, 14, 19(all partially)
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:

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

Continuation of Box II.2

Claims Nos.: 7-9, 14, 19(all partially)

Claims 7, 9, and 19 do not meet the requirements of Article 6 PCT because the matter for which protection is sought is not clearly defined. The unit "micron" is unclear and not part of the metric system, as required by Rule 10.1(a) PCT. Here it was assumed that "micron" refers to the metric unit "micrometer". Claim 8 does not meet the requirements of Article 6 PCT because the matter for which protection is sought is not clearly defined. In said claim it is stated "abrasive particles have a mesh size of from 400 to 1200". In principle, particles do not have a mesh size. It was assumed here that it was meant that the particles have such a size that the smallest ones are rejected by a mesh having 1200 openings per inch, and the biggest ones are rejected by a mesh having 400 openings per inch. However, the size of the openings and of the wires in between is not defined. Here, it was approximated that 400 and 1200 mesh correspond to about 37 and 12.5 micrometers respectively. Finally, 12.5-37 micrometer go beyond the range of 1-20 micrometer referred to in claim 7. Accordingly, it was assumed that claim 8 depends on claim 1 (not on claim 7). Claim 9 does not meet the requirements of Article 6 PCT because the matter for which protection is sought is not clearly defined. In said claim it is stated "abrasive particles have a 600 mesh size, a particle size distribution of from 5 microns to 20 microns ". In principle, particles do not have a mesh size. It was assumed here that it was meant that the particles have such a size that they are all rejected by a mesh having 600 openings per inch. However, the size of the openings and of the wires in between is not defined. Here, it was approximated that 600 mesh corresponds to a maximum particle diameter of about 20-25 micrometers. Finally, 20-25 micrometer goes beyond the range of 5-20 micrometer referred to in the same claim 9. Accordingly, it was assumed that the particle size distribution defined in claim 9 is about 5-25 micrometer. Claim 14 does not meet the requirements of Article 6 PCT because the matter for which protection is sought is not clearly defined. In the feature "1:1:20 solution of HF:HCl:H₂O" it is not defined if said ratios are based on volume, weigh, molarity, or another measure. It was assumed that said ratios are based on either volume or weigh or molarity, and no further alternative option was considered. Claim 19 does not meet the requirements of Article 6 PCT because the matter for which protection is sought is not clearly defined. In said claims "particles" are referred to that are not defined. In view of paragraph 24 of the description, the word "particles" was interpreted as "surface". The International Search was restricted on the basis of Article 17(2)(b) PCT to the features listed in the above paragraphs.

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

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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.