According to an aspect of an embodiment of the present disclosure, there is provided a solar cell panel and a method for manufacturing the same. The solar cell panel comprises: a solar cell for generating electric power from sunlight; a coverglass for covering the solar cell; transparent shims, which are disposed between the solar cell and the coverglass at the points where the distance between the solar cell and the coverglass needs to be controlled, and form a space between the solar cell and the coverglass; and adhesive layer, which fills the space between the solar cell and the coverglass and has the thickness the same as that of the transparent shims.

Preparation of transparent shims with predetermined thickness

Placing the transparent shims on the solar cell and/or the coverglass

Dispensing the adhesive onto the solar cell and/or the coverglass

Combining the solar cell and the coverglass

Curing the adhesive

Start

S401

S402

S403

S404

S405

End

10 Claims, 6 Drawing Sheets
Start

Preparing transparent shims with predetermined thickness

Placing the transparent shims on the solar cell and/or the cover glass

Dispensing the adhesive onto the solar cell and/or the cover glass

Combing the solar cell and the cover glass

Curing the adhesive

End

FIG. 4
Start

Placing the spacer with predetermined thickness on the flat surface S501

Dispensing the transparent material on a flat surface S502

Placing a flat plate on top of the transparent material layer S503

Curing the transparent material layer S504

Removing the flat plate S505

Removing the flat plate S506

End

FIG. 5
Start

Disposing the mask on a flat surface (S701)

Skiving the transparent material onto the mask (S702)

Curing the material (S703)

Removing the mask from the flat surface (S704)

End

FIG. 7
Panel as used herein refers to any type of supporting or forming air-tight/liquid-tight seal therebetween. The term 'panel' is used herein to refer to a substrate, a transparent shims, such as solar cell, coverglass, a mounting member, and adhesive layer, which is disposed and interconnected as an array via wire and diodes.

In prior art, when attaching the coverglass to the solar cell, opaque mechanical shims are used to support the coverglass on the solar cell, and then the adhesive layer is disposed between the solar cell and the coverglass, such that the thickness of the adhesive layer is determined by the opaque shims. However, after the adhesive is cured, the opaque shims have to be removed. The disadvantages of this technique are that (a) removing the opaque shims was tedious and time consuming, and required back-filling the voids with fresh adhesive; (b) removing the opaque shims was mechanically disruptive and often damaged the solar cell panels by cracking the corners, resulting in scraping those parts.

Thus, a solar cell panel and the method for manufacturing such solar cell panel, which can overcome the above disadvantages, are needed in the art.

SUMMARY

According to an aspect of an embodiment of the present disclosure, there is provided a solar cell panel, comprising: a solar cell for generating electric power from sunlight; a coverglass for covering the solar cell; transparent shims, which are disposed between the solar cell and the coverglass at the points where the distance between the solar cell and the coverglass needs to be controlled, and form a space between the solar cell and the coverglass; and adhesive layer, which fills the space between the solar cell and the coverglass and has the thickness the same as that of the transparent shims.

According to another aspect of an embodiment of the present disclosure, there is provided method for manufacturing a solar cell panel, comprising the steps of: preparing transparent shims with predetermined thickness; placing the transparent shims on the solar cell for generating electric power from sunlight or a coverglass for covering the solar cell; at the points where the distance between the solar cell and the coverglass needs to be controlled; dispensing adhesive onto the solar cell or the coverglass; combining the solar cell and the coverglass, such that in the combined panel, the transparent shims and the adhesive is sandwiched between the solar cell and the coverglass and the thickness of the adhesive is the same as that of the transparent shims; and curing the adhesive.

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. 1 is a simplified exploded view schematically illustrating a solar cell panel according to an embodiment of the present disclosure, in which the adhesive layer is omitted for clarity.

FIG. 2 is a simplified perspective view schematically illustrating a solar cell panel according to an embodiment of the present disclosure, in which the adhesive layer is omitted for clarity.

FIG. 3 is a simplified top view schematically illustrating the position of the transparent shims relative to the solar cell panel according to an embodiment of the present disclosure.

FIG. 4 is an exemplary flow chart of method for manufacturing the solar cell panel according to an embodiment of the present disclosure.

FIG. 5 is an exemplary flow chart of method for manufacturing the transparent shims according to an embodiment of the present disclosure.

FIG. 6 is a simplified perspective view illustrating the mask for manufacturing the transparent shims according to an embodiment of the present disclosure.

FIG. 7 is another exemplary flow chart of method for manufacturing the transparent shims according to an embodiment of the present disclosure.

DESCRIPTION OF THE EMBODIMENTS

Embodiments of the present disclosure will be described in detail below with reference to the drawings. Note that similar reference numerals are used to refer to similar elements throughout the drawings, and thus repetitive descriptions thereof are omitted.

FIG. 1 is a simplified exploded view schematically illustrating a solar cell panel according to an embodiment of the present disclosure. FIG. 2 is a simplified perspective view schematically illustrating a solar cell panel according to an embodiment of the present disclosure.
The solar cell panel 100 includes a solar cell 101 for generating electric power from sunlight, a coverglass 102 for covering the solar cell, transparent shims 103 for supporting the coverglass 102 on the solar cell 101 and an adhesive layer for bonding and encapsulating the solar cell panel 100. The transparent shims 103 are disposed between the solar cell 101 and the coverglass 102 at the points where the distance between the solar cell 101 and the coverglass 102 needs to be controlled, and therefore form a space between the solar cell 101 and the coverglass 102 when they are combined. The adhesive layer fills the space between the solar cell 101 and the coverglass 102 and has the thickness the same as that of the transparent shims 103. The adhesive layer can be made of an adhesive (for example, Nusil CV-2500) or an encapsulant (for example, Dow Corning DC93-500). For clarity, the adhesive layer is omitted in FIGS. 1 and 2.

FIG. 3 is a simplified top view schematically illustrating the positions of the transparent shims relative to the solar cell panel. The solid line shows the outline of a possible solar cell panel 100, and the dotted squares show the outline and possible positions of seven transparent shims 103. These shims of transparent material should be placed onto the solar cell panel at the points where the bond line thickness needs to be controlled. They can be placed in the corners, or along the edges, or in the middle, or anywhere that the bond line thickness needs to be controlled. The shape and size of the solar cell panel, and the size, the shape and the locations of the transparent shims are merely for illustration. In one embodiment, the shims may be approximately 2 mm x 2 mm squares, with the thickness of about 8 mil.

With the above configuration, the thickness of the adhesive layer can be controlled by the thickness of the transparent shims 103, and it is not necessary to remove the transparent shims 103 after the adhesive is cured, thereby facilitating the manufacturing of the solar cell panel 100.

Fig. 4 is an exemplary flow chart of method for manufacturing the solar cell panel according to an embodiment of the present disclosure.

At step S401, transparent shims 103 with predetermined thickness are prepared. In some embodiments, the transparent shims are prepared in advance and stored for later use. The process for preparing the transparent shims will be described in detail later.

At step S402, the transparent shims 103 are placed on the solar cell 101 and/or the coverglass 102, at the points where the distance between the solar cell 101 and the coverglass 102 needs to be controlled. In some embodiment, the transparent shims are placed on the solar cell, or on the coverglass, or on both of them. The transparent shims can be wetted with the adhesive in advance, in order to reduce the formation of bubbles.

At step S403, an adhesive is dispensed onto the solar cell 101 and/or the coverglass 102. Based on the requirement on hand, the adhesive can be dispensed on either one or both of the solar cell 101 and the coverglass 102, which may or may not have transparent shims disposed on them yet. The step S403 can be carried out before, after or in parallel with the step S402. The adhesive can be degassed before being dispensed.

At step S404, the solar cell 101 and/or the coverglass 102 are combined, such that in the combined structure, the transparent shims 103 and the adhesive are sandwiched between the solar cell 101 and the coverglass 102 and the thickness of the adhesive layer is the same as that of the transparent shims 103. In order to ensure the thickness of the adhesive layer, weight can be placed on top of the combined structure, to ensure that the adhesive levels out to the desired thickness. In some embodiments, by injecting the adhesive into the space formed by the solar cell 101, the coverglass 102 and the transparent shims 103, the step S403 can be carried out after step S404.

At step S405, the adhesive is cured, and then the process ends. The adhesive can be thermosetting or thermoplastic adhesive. In the case of thermosetting adhesive, the combined structure is disposed in an oven for example at 70°C for 30 minutes, to allow the adhesive to cure, and then is removed from the oven. The adhesive can be pre-cured in an oven for example at 70°C for 3 minutes, to the extent that the solar cell 101 and the coverglass 102 remain movable with respect to each other, and then the alignment between the solar cell 101 and the coverglass 102 can be verified and adjusted.

Based on the above process, the solar cell panel according to the embodiments of the present invention is manufactured. The transparent shims can be prepared in many ways. Below, the example of the process of preparing the transparent shims is described with reference to FIG. 5.

FIG. 5 is an exemplary flow chart of method for manufacturing the transparent shims. At step S501, shims are prepared in advance and stored for later use. The steps S502-S506 are distributed in additional units/operations, and units/operations may be altered in various other embodiments. The above described orders of the steps for the methods are only intended to be illustrative, and the steps of the methods of the present disclosure are not limited to the above specifically described orders unless otherwise specifically stated. Furthermore, those skilled in the art will recognize that boundaries between the above described operations merely illustrative. The multiple units/operations may be combined into a single unit/operation, a single unit/operation may be distributed in additional units/operations, and units/operations may be operated at least partially overlapping in time. Moreover, alternative embodiments may include multiple instances of a particular unit/operation, and the order of operations may be altered in various other embodiments.

FIG. 6 shows the case in which a mask 602 is disposed on a flat surface 601. In the mask 602, through holes 603, which define the shape and the thickness of the transparent shims, are formed. FIG. 7 is another exemplary flow chart of method for manufacturing the transparent shims. As shown in FIG. 7, the transparent shims are formed in the following steps: At step S701, the mask 602 is disposed on the flat surface 601; at step S702, the transparent material is skived onto the mask 602; at step S703, the transparent material is cured; and at step S704, the mask 602 is removed from the flat surface 601.

It is appreciated that the transparent shims can be prepared in a variety of ways, and the specification merely disclosed some of its examples. The present invention can be embodied in various ways.
from the scope and spirit of the present invention which are to be defined by the attached claims.

The invention claimed is:

1. A method for manufacturing a solar cell panel, comprising the steps of:
   preparing transparent shims with predetermined thickness;
   placing the transparent shims on a solar cell for generating electric power from sunlight and/or a coverglass for covering the solar cell, at the points where the distance between the solar cell and the coverglass needs to be controlled;
   dispensing adhesive onto the solar cell and/or the coverglass;
   combining the solar cell and the coverglass, such that the transparent shims and the adhesive is sandwiched between the solar cell and the coverglass and the thickness of the adhesive is the same as that of the transparent shims; and
   curing the adhesive.

2. The method of claim 1, wherein before the step of placing the transparent shims, the transparent shims can be wetted with the adhesive.

3. The method of claim 1, wherein the step of dispensing the adhesive can be carried out before, after or in parallel with the step of placing the transparent shims.

4. The method of claim 1, wherein the step of combining the solar cell and the coverglass further comprising placing weight on the combined structure, to level out the adhesive to the predetermined thickness.

5. The method of claim 1, wherein before the step of curing the adhesive, the method further comprising the step of pre-curing the adhesive, and verifying and adjusting the alignment between the solar cell and the coverglass.

6. The method of claim 5, wherein the step of pre-curing the adhesive comprising curing the adhesive to the extent that the solar cell and the coverglass remain movable with respect to each other.

7. The method of claim 1, wherein the step of preparing the transparent shims further comprising:
   placing spacers with predetermined thickness on a flat surface at desired places;
   dispensing transparent material on the flat surface;
   placing a flat plate on top of the transparent material layer; such that the thickness of the transparent material layer is the same as that of the spacers;
   curing the transparent material layer;
   removing the flat plate; and
   cutting the transparent material layer into the transparent shims.

8. The method of claim 7, wherein the flat surface and the flat plate are microscope slides.

9. The method of claim 7, wherein before the step of curing the transparent material layer, the flat plate can be weighted.

10. The method of claim 1, wherein the step of preparing the transparent shims further comprising:
    disposing a mask on a flat surface, wherein the mask has through holes defining the shape and the thickness of the transparent shims;
    skiving the transparent material onto the mask;
    curing the transparent material; and
    removing the mask.