PHOTOVOLTAIC SKYLIGHT AND METHOD OF MANUFACTURE THEREFOR

FIELD OF THE INVENTION

The present invention relates to a photovoltaic skylight and method of production therefor. More particularly but not exclusively it relates to a photovoltaic skylight which may be easily produced, and which is conveniently installable.

BACKGROUND TO THE INVENTION

Photovoltaic solar cells are well known world wide. In the global move to sustainable energy, the sustainable and convenient use of the sun to produce energy is one of the leading concepts. A large amount of resources are being used to develop the scientific principles behind photovoltaic (PV), or solar power, to make the production of solar power more efficient and cheaper. However, to make these new developments practically usable and even more economically feasible, the practical application of these photovoltaic panels to domestic and commercial duties requires development.

Patent application GB 2 407 634 is a publication which is directed to such practical application of photovoltaic panels. It describes a solar thermal tile including a chassis or frame surrounding a transparent portion though which energy from the sun is transmitted to heat up an interior portion or a water pipe by radiation. Alternatively, the transparent portion may allow light through to a PV panel. As an option, the tile may be integrally moulded. The tile is configured to be incorporated in a set of tiles on a building surface, such as a roof etc. This patent application shows one example of how inventors are attempting to make the use of solar energy more convenient.

An important consideration for incorporating a PV panel into a construction is that the PV panel mast be as weather proof and as structurally sound as the part that it is replacing. This may not always be economically feasible. The above patent application describes the use of a manufactured metal chassis which supports a polycarbonate transparent section or a PV panel. However, there are difficulties involved in sealing a metal chassis to a PV panel, and weather proofing issues may arise.

In the past, thermoplastics have been used in a moulding process to form a one-piece structure incorporating a PV panel. However, the use of injection moulding of thermoplastics is disadvantageous in that it requires several moulding steps. Furthermore, the moulded plastic panel may not be structurally sound enough to handle to withstand structural incorporation within a construction structure.

Another example of moulding is disclosed in US patent application US 2006/0225776. This shows the use of a reaction injection moulding process to form an integrally moulded PV panel. The PV panel is then mounted to a "curb" which has a flange region for mounting to a rooftop and sealing in a manner known to those skilled in the art of skylight installation. The system described in this publication is disadvantageous in that several steps are necessary to install the skylight in place on a roof, and also because sealing problems may develop between the moulded PV panel and the curb.

In this specification, where reference has been made to external sources of information, including patent specifications and other documents, this is generally for the purpose of providing a context for discussing the features of the present invention. Unless stated otherwise, reference to such sources of information is not to be construed, in any jurisdiction, as an admission that such sources of information are prior art or form part of the common general knowledge in the art.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a photovoltaic skylight and method of production therefor which overcomes or at least ameliorates some of the abovementioned disadvantages or which at least provides the public with a useful choice.

SUMMARY OF THE INVENTION

In a first aspect the present invention broadly consists in a photovoltaic (PV) skylight comprising

a photovoltaic (PV) panel;

a frame element including

a reaction injection moulded (RIM) portion, and

a reinforcing insert integrally moulded with the RIM portion; and

wherein the PV panel is integrally moulded with the frame element.

Preferably, the frame element extends substantially around the periphery of the PV panel.

Preferably, the PV skylight includes mounting means suitable for mounting the PV skylight to a construction.

Preferably, the mounting means is at least one mounting formation suitable for mounting the PV skylight operationally to a construction.

Preferably, the mounting formations are a plurality of mounting holes.

Preferably, the mounting holes extend through the RIM portion of the frame element as well as the reinforcing insert.

Preferably, the mounting means comprises a mounting bracket.

Preferably, the mounting means further comprises securing connectors suitable for securing the mounting brackets to a construction.

Preferably, the RIM portion is integrally moulded with the PV panel so that the interface between the PV panel and the frame element is sealed.

Preferably, the RIM portion has a shore A hardness of 40-95.

Preferably, the frame element includes at least one sealing formation for sealing the photovoltaic skylight when mounted in operation to render the mounted PV skylight weatherproof.

Preferably, the frame element includes a plurality of sealing formations.

Preferably, the sealing formation extends substantially around the periphery of the frame element.

Preferably, the sealing formations are configured to be deformed when the PV skylight is secured in operation, thereby sealing the frame element against the construction.

Preferably, the sealing formation is a protruding ridge extending from the frame element.

Preferably, the protruding ridge extends operationally downwardly from the frame element.

Preferably, the frame element includes a pair of protruding ridges.

Preferably, the PV panel may comprise a solar cell sandwiched between a pair of transparent plates.

Preferably, one of the transparent plates extends at least partially outwardly beyond the opposed transparent plate.

Alternatively, the transparent panels are substantially similarly configured and dimensioned so that the edges of adjacent transparent panels align with each other.

Preferably the PV panel is integrally moulded with the RIM portion so that the RIM portion extends from the top surface of the PV panel in the same plane to form a flat surface.

Preferably, the reinforcing insert is composed of a rigid material selected from one or more of aluminium, stainless steel or steel, an alloy of these, and rigid thermoplastic.

Preferably, the reinforcing insert is a reinforcing frame.

Preferably, the PV skylight includes an electrical connection.

Preferably, the electrical connection is connectable to the PV panel.

Preferably, the electrical connection is integrally formed with the frame element.

Preferably, the electrical connection is for housing connection points suitable for connecting the PV panel to a power network.

In a further aspect the present invention broadly consists in a method of manufacture of a photovoltaic skylight comprising the steps of

providing a photovoltaic (PV) panel;

providing a reinforcing insert;

integrally moulding the reinforcing insert and PV panel by reaction injection moulding to form a frame element which surrounds at least part of the periphery of the PV panel.

Preferably, the method further comprises integrally moulding a sealing formation onto the frame element when the frame element is moulded.

Preferably, the method further comprises the step of providing an electrical connection.

Preferably, the method further comprises integrally moulding the electrical connection with the frame element when the frame element is moulded.

Alternatively, the method further comprises the step of connecting the electrical connection to one or both of the frame element or the PV panel.

Other aspects of the invention may become apparent from the following description which is given by way of example only and with reference to the accompanying drawings.

As used herein the term "and/or" means "and" or "or", or both.

As used herein "(s)" following a noun means the plural and/or singular forms of the noun.

The term "comprising" as used in this specification [and claims] means "consisting at least in part of". When interpreting statements in this specification [and claims] which include that term, the features, prefaced by that term in each statement, all need to be present but other features can also be present. Related terms such as "comprise" and "comprised" are to be interpreted in the same manner.

The entire disclosures of all applications, patents and publications, cited above and below, if any, are hereby incorporated by reference.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.)

To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described by way of example only and with reference to the drawings in which:

Figure 1: shows a perspective bottom view of a corner of a first embodiment of a PV skylight, showing an electrical junction box;

Figure 2: shows a cutaway close up side view of the cross section of a frame element and PV panel of a first embodiment of a PV skylight;

Figure 3: shows a cutaway top perspective view of a first embodiment of a PV skylight;

Figure 4: shows a cutaway perspective top view of a first embodiment of a PV skylight;

Figure 5: shows a top perspective view of a first embodiment of a PV skylight;

Figure 6: shows a bottom perspective view of a first embodiment of a PV skylight;

Figure 7: shows a cutaway close up side view of the cross section of a frame element and PV panel of a second embodiment of a PV skylight including an upper ridge around the periphery of the PV panel;

Figure 8: shows a cutaway perspective top view of the second embodiment of a PV skylight shown in figure 7;

Figure 9: shows a cutaway side view of the first embodiment of a PV skylight mounted on a set of construction elements;

Figure 10: shows a cutaway side view of the first embodiment of a PV skylight mounted and fastened onto a set of construction elements;

Figure 11: shows a cutaway close up side view of a third embodiment of a PV skylight showing an alternative configuration and shape of protruding ridges;

Figure 12: shows a cutaway close up side view of a fourth embodiment of a PV skylight showing an alternative configuration and shape of protruding ridges;

Figure 13: shows a cutaway close up side view of a fifth embodiment of a PV skylight showing an alternative configuration and shape of protruding ridges;

Figure 14: shows a perspective bottom view of a sixth embodiment of a PV skylight showing electrical connectors extending inwardly;

Figure 15: shows a perspective top view of a seventh embodiment of a PV skylight showing electrical connectors extending outwardly;

Figure 16: shows a close up cutaway view of the first embodiment of a PV skylight mounted on and fastened to a construction element to deform the sealing formations by means of screws screwed into mounting holes;

Figure 17: shows a cutaway side view of an eighth embodiment of a PV skylight mounted on and fastened to a construction element to deform the sealing formations by means of mounting brackets and screws; and

Figure 18: shows a cutaway close up side view of the eighth embodiment of a PV skylight shown in figure 17**.**

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

With reference to the above drawings, a photovoltaic (PV) skylight according to a first aspect of the invention is generally indicated by the numeral 100.

In one embodiment now described, there is provided a PV skylight 100 comprising a photovoltaic (PV) panel 110, and a frame element 120. The frame element 120 includes a reaction injection moulded (RIM) portion 130, and a reinforcing insert140 which has been integrally moulded with the RIM portion 130. The PV panel 110 is integrally moulded with the frame element 120. The RIM portion 130 extends around the periphery of the PV panel 110. The RIM portion 130 is expected to typically have a shore A hardness in the range of between 40-95. One preferred embodiment of the PV panel 100 (shown in figures 1-16) includes mounting means in the form of a plurality of mounting holes 150 extending through the RIM portion 130 and reinforcing insert 140 around the periphery of the frame element 120. The mounting holes 150 are suitable for mounting the PV skylight 100 operationally to a construction element 300 such as a beam, joist or the like. In another embodiment, the PV panel 100 may include mounting means in the form of mounting brackets 180 and securing connectors 190 in the form of bolts or screws, which are used to secure the PV skylight 100 to a construction element 300 (as shown in figures17 and 18)

The RIM portion 130 is integrally moulded with the PV panel 110 so that the interface between the PV panel 110 and the frame element 120 is sealed. In the embodiment shown in figures 1-6, the frame element 120 extends from the PV panel 110 as a single plane, making the PV skylight 100 more aesthetically pleasing, and allowing for convenient rainwater run-off if the PV panel 100 is mounted on a roof (not shown). However, this may not necessarily be the case, and the RIM portion 130 can be in the form of provide an upper rim 132 (as shown in figures 7, 8 and 15) around the periphery of the PV panel 110.

A pair of sealing formations 160 in the form of protruding ridges 162 which have been moulded into the RIM portion 130 of the frame element 120 are included. These protruding ridges 162 extend operationally downwardly, and extend around the periphery of the frame element 120.

It is envisaged that the protruding ridges 162 will be made of the same material as the RIM portion 130, namely polyurethane, and the protruding ridges 162 will be deformable against the construction (as shown in figures 10, 13, 16, 17 and 18) when the PV skylight 100 is mounted to the construction, thereby rendering the PV skylight 100 weatherproof. The protruding ridges 162 could typically be of any number and have a wide variety of cross sectional shapes. A few varieties of shapes and configurations are shown in figures 7, 11, 12 and 13.

It is envisaged that the PV panel 110 will be of a known construction, and will comprise a solar cell 112 sandwiched between a pair of transparent plates 114. The transparent plates 114 may be composed of glass, plastic, polycarbonate, or any other suitable material. In one embodiment as shown in figure 2, the lower transparent plate 114a extends outwardly beyond the upper transparent plate 114b, forming a generally step-like formation 116. This step-like formation 116 allows the RIM portion 130 to be moulded onto the PV panel 110 in a secure fashion.

However, this configuration is not essential, and the two transparent panes 114a and 114b may coincide in shape and dimension so that when they are laid adjacent each other, their peripheral edges are aligned with each other (as shown in figures 7 and 8). In such a case, the RIM portion 130 would merely be moulded around the peripheral edges of both transparent plates 114a & 114b.

The reinforcing insert 140 is L-shaped in cross section for increased stiffness, although it is envisaged that the reinforcing insert 140 could have many alternative cross sectional shapes. It is further envisaged that it will be composed of a stiff material, such as metal, and preferably aluminium, steel, stainless steel, or an alloy of these. The reinforcing insert 140 extends in association with the RIM portion 130 around the outer edge of the PV panel 110 to form a rectangular reinforcing frame (not shown).

In a preferred embodiment as shown in figure 6 and figure 1, the PV skylight 100 further comprises an electrical connection in the form of an electrical junction box 170, which is connecting the solar cells within to the outside world. It is envisaged that the electrical junction box 170 can be integrally moulded with the RIM portion, or alternatively can be connected to the PV panel 110 or frame element 120 by known means such as bonding. The electrical junction box 170 houses electrical connection points (not shown) suitable for connecting the PV panel 110 to a power network (not shown).

In one embodiment, the junction box 170 is composed of a pre-moulded thermoplastics material and is then connected to the frame element 120 or PV panel, but alternatively it is envisaged that the electrical junction box 170 can be integrally moulded as part of the RIM portion 130.

It is envisaged that the PV skylight 100 may not include an electrical junction box at all, but could just be moulded with electrical connectors 118 from the solar cell 112 extending from the

RIM portion 130 (as shown in figures 14 and 15). The connectors may extend inwardly (as shown in figure 14), or outwardly (as shown in figure 15) for connection to an electrical power network (not shown).

The envisaged method of manufacturing the PV skylight 100 described above will include the steps of providing a photovoltaic (PV) panel 110, a reinforcing insert 140 and an electrical junction box 170; and integrally moulding the reinforcing insert 140 and PV panel 110 to each other by reaction injection moulding to form a frame element which surrounds at least part of the periphery of the PV panel. In one method, the electrical junction box 170 is connected to either the frame element 120 or the PV panel 110 in a separate step, but alternatively the electrical junction box can be integrally moulded as part of the frame element 120 when the frame element is created by RIM moulding. In an alternative step, the electrical junction box can be moulded by RIM moulding as part of the frame element 120 when the frame element is created by RIM moulding. The protruding ridges are also moulded as part of the frame element during the RIM moulding process.

It will be appreciated that the PV skylight 100 and method of producing the PV skylight 100 described above offers significant advantages over prior art in that no separate mounting step is required to install the PV skylight 100 on a construction or building. Further, the inclusion of the reinforcing insert 140 allows the PV skylight 100 to have the requisite rigidity for convenient installation while protecting the fragile PV panel 110.

Where in the foregoing description reference has been made to elements or integers having known equivalents, then such equivalents are included as if they were individually set forth.

Although the invention has been described by way of example and with reference to particular embodiments, it is to be understood that modifications and/or improvements may be made without departing from the scope or spirit of the invention.

In addition, where features or aspects of the invention are described in terms of Markush groups, those skilled in the art will recognise that the invention is also thereby described in terms of any individual member or subgroup of members of the Markush group.

CLAIMS:

1. A photovoltaic (PV) skylight comprising
   a photovoltaic (PV) panel; and
   a frame element including
   a reaction injection moulded (RIM) portion, and
   an reinforcing insert integrally moulded with the RIM portion;
   wherein the PV panel is integrally moulded with the frame element.
2. A PV skylight as claimed in claim 1, wherein the frame element extends substantially around the periphery of the PV panel.
3. A PV skylight as claimed in claim 1 or 2, wherein the PV skylight further includes mounting means suitable for mounting the PV skylight to a construction.
4. A PV skylight as claimed in claim 3, wherein the mounting means is at least one mounting formation suitable for mounting the PV skylight operationally to a construction.
5. A PV skylight as claimed in claim 4, wherein the mounting formations are a plurality of mounting holes.
6. A PV skylight as claimed in claim 5, wherein the mounting holes extend through the RIM portion of the frame element as well as the reinforcing insert.
7. A PV skylight as claimed in claim 3, wherein the mounting means comprises a mounting bracket.
8. A PV skylight as claimed in claim 7, wherein the mounting means further comprises securing connectors suitable for securing the mounting brackets to a construction.
9. A PV skylight as claimed in any of the preceding claims, wherein the RIM portion is integrally moulded with the PV panel so that the interface between the PV panel and the frame element is sealed.
10. A PV skylight as claimed in any of the preceding claims, wherein the RIM portion has a shore A hardness of 40-95.
11. A PV skylight as claimed in any of the preceding claims, wherein the frame element includes at least one sealing formation for sealing the photovoltaic skylight when mounted in operation to render the mounted PV skylight weatherproof.
12. A PV skylight as claimed in claim 11, wherein the frame element includes a plurality of sealing formations.
13. A PV skylight as claimed in any of claims 11-12, wherein the sealing formation(s) extend substantially around the periphery of the frame element.

14. A PV skylight as claimed in any of claims 11-13, wherein the sealing formations are configured to be deformed when the PV skylight is secured in operation, thereby sealing the frame element against the construction.
15. A PV skylight as claimed in any of claims 11-14, wherein the sealing formation(s) is a protruding ridge extending from the frame element.
16. A PV skylight as claimed in claim 15, wherein the protruding ridge extends operationally downwardly from the frame element.
17. A PV skylight as claimed in any of claims 15-16, wherein the frame element includes a pair of protruding ridges.
18. A PV skylight as claimed in any of the preceding claims, wherein the PV panel comprises a solar cell sandwiched between a pair of transparent plates.
19. A PV skylight as claimed in any of claims 17-18, wherein one of the transparent plates extends at least partially outwardly beyond the opposed transparent plate.
20. A PV skylight as claimed in any of claims 17-18, wherein the transparent panels are substantially similarly configured and dimensioned so that the edges of adjacent transparent panels align with each other.
21. A PV skylight as claimed in any of the preceding claims, wherein the PV panel is integrally moulded with the RIM portion so that the RIM portion extends from the top surface of the PV panel in the same plane as the PV panel to form a flat surface.
22. A PV skylight as claimed in any of the preceding claims, wherein the reinforcing insert is composed of a rigid material selected from one or more of aluminium, stainless steel or steel, an alloy of these, and rigid thermoplastic.
23. A PV skylight as claimed in any of the preceding claims, wherein the reinforcing insert is a reinforcing frame.
24. A PV skylight as claimed in any of the preceding claims, wherein the PV skylight includes an electrical connection.
25. A PV skylight as claimed in claim 24, wherein the electrical connection is connectable to the PV panel.
26. A PV skylight as claimed in any of claims 24-25, wherein the electrical connection is integrally formed with the frame element.
27. A PV skylight as claimed in any of claims 24-26, wherein the electrical connection is for housing connection points suitable for connecting the PV panel to a power network.
28. A method of manufacture of a photovoltaic (PV) skylight comprising the steps of

    providing a photovoltaic (PV) panel;

providing a reinforcing insert; and

integrally moulding the reinforcing insert and PV panel by reaction injection moulding to form a frame element which surrounds at least part of the periphery of the PV panel.

29. A method as claimed in any of claims 28, wherein the method further comprises integrally moulding a sealing formation onto the frame element when the frame element is moulded.

30. A method as claimed in claim 28 or 29, wherein the method further comprises the step of providing an electrical connection.

31. A method as claimed in claim 29, wherein the method further comprises integrally moulding the electrical connection with the frame element when the frame element is moulded.

32. A method as claimed in claim 29, wherein the method further comprises the step of connecting the electrical connection to one or both of the frame element or the PV panel.