

A building integrated photovoltaic panelTechnical Field

The present invention relates to a building integrated photovoltaic (BIPV) panel.

5 Background

Photovoltaic (PV) devices are generally installed at rooftops. However, in order to obtain maximise use, it would be advantageous to use PV devices on outer walls of buildings to efficiently use solar light. However, building integrated photovoltaic (BIPV) modules are still not commonly adopted in building construction. This is because most
10 BIPV modules are glazing curtain wall products, applied to semi-transparent vision windows or opaque spandrel walls. Semi-transparent PVs not only have low power generation but also transfer heat into the interior. Installation of BIPV modules is also time consuming in view of the cumbersome installation due to wiring of the modules.

There is therefore a need for a BIPV panel which may be suitably used with ease and
15 convenience.

Summary of the invention

The present invention seeks to address these problems, and/or to provide a BIPV panel.

According to a first aspect, the present invention provides a building integrated
20 photovoltaic (BIPV) panel comprising:

- a support structure for supporting the BIPV panel;
- a photovoltaic (PV) module provided adjacent a surface of the support structure;
- a module-level power electronic (MLPE) for optimizing power generation of
25 the PV module;
- an insulation layer provided between the PV module and the support structure; and
- a cavity layer provided between the PV module and the support structure.

30 The support structure may be made of any suitable material. For example, the support structure may be made of steel, aluminium, concrete, wood or a combination thereof.

According to a particular aspect, each of the two opposing surfaces of the support structure may be covered by a first cover member and a second cover member, respectively.

According to a particular aspect, the PV module may comprise a photovoltaic device.

- 5 For example, the PV module may comprise an opaque photovoltaic device, a semi-transparent photovoltaic device, or a combination thereof.

The BIPV panel may further comprise a frame structure for encasing the PV module.

The BIPV panel may further comprise a covering layer to protect the PV module surface. For example, the covering layer may be transparent.

- 10 The BIPV panel may further comprise a vapour barrier layer between the cavity layer and the insulation layer.

The BIPV panel according to any preceding claim, wherein the insulation layer comprises a filling of insulation material.

- The BIPV panel according to any preceding claim, wherein the BIPV panel comprises a wiring channel dimensioned to provide a passage for wiring bussing.
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The BIPV panel according to any preceding claim, wherein the BIPV panel is prefabricated.

Brief Description of the Drawings

- In order that the invention may be fully understood and readily put into practical effect there shall now be described by way of non-limitative example only exemplary embodiments, the description being with reference to the accompanying illustrative drawings. In the drawings:
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Figure 1 shows a representation of a front view and back view the BIPV panel according to one embodiment;

- 25 Figure 2 shows an exploded view of the various layers of the BIPV panel according to one embodiment;

Figure 3 shows a schematic representation of a sectional view of the BIPV panel according to one embodiment; and

Figure 4 shows a schematic representation of the process of assembling the BIPV panel according to one embodiment.

5 Detailed Description

As explained above, there is a need for an improved BIPV panel which may be conveniently installed and incorporated into building façade.

In general terms, the invention relates to a BIPV panel which may be full prefabricated and which can be easily installed. The BIPV panel may also provide suitable electrical
10 efficiency while satisfying functional requirements of a building skin, thereby provided both building construction and installation of a BIPV system with a single installation and avoiding the need for an additional BIPV integration.

According to a first aspect, the present invention provides a building integrated photovoltaic (BIPV) panel comprising:

- 15 - a support structure for supporting the BIPV panel;
- a photovoltaic (PV) module provided adjacent a surface of the support structure;
- a module-level power electronic (MLPE) for optimizing power generation of the PV module;
- 20 - an insulation layer provided between the PV module and the support structure; and
- a cavity layer provided between the PV module and the support structure.

As used herein, the term “building integrated photovoltaic panel” or “BIPV panel”
25 generally refers to photovoltaic systems integrated with building materials to form at least a portion of a building envelope. For example, the BIPV panel may form the roof or wall of a building structure. The BIPV panel may be retrofitted, be a part of a new constructions roof or wall, or a combination of both.

A schematic representation of an embodiment of the BIPV panel is as shown in Figure
30 1, with the representations in Figures 2 and 3 providing more details of the BIPV panel.

As shown in Figures 2 and 3, there is provided a BIPV panel 200. The BIPV panel comprises a support structure 202. The support structure 202 may be made of any suitable material. According to a particular aspect, the material for forming the support structure 202 may be strong and light. For example, the support structure 202 may be made of, but not limited to, steel, aluminium, concrete, wood, or a combination thereof.
5 The wood may be any suitable wood such as timber wood. In particular, the support structure 202 may be made of steel. Even more in particular, the support structure 202 may be made of light gauge steel.

The support structure 202 may have a suitable thickness. For example, the thickness
10 of the support structure 202 may be 2-1000 mm. In particular, the support structure 202 may have a thickness of about 5-900 mm, 10-800 mm, 15-700 mm, 25-600 mm, 50-500 mm, 100-400 mm, 200-300 mm. Even more in particular, the support structure 202 may have a thickness of about 2-5 mm, preferably about 2 mm.

The support structure 202 may have any suitable channel. For example, the channel
15 may be a C-shaped channel or I-shaped channel.

The support structure 202 may be coated with suitable coatings. For example, the support structure 202 may be coated with a fireproof coating.

Each of the two opposing surfaces of the support structure 202 may be covered by a first cover member 204 and a second cover member 206. The first cover member 204 and the second cover member 206 may be made of any suitable material. For
20 example, the first cover members 204 and the second cover member 206 may each be made of the same or different material from each other. According to one aspect, the first cover member 204 and the second cover member 206 may be formed of the same material. The material may comprise, but is not limited to, cement, silica, plaster board, wood board, or a combination thereof. For example, the wood board may be a timber
25 wood board.

The first cover member 204 and the second cover member 206 may have any suitable thickness. For example, the thickness of each of the first cover member 204 and the second cover member 206 may be 5-200 mm. In particular, the thickness of each of
30 the first cover member 204 and the second cover member 206 may be 8-150 mm, 10-100 mm, 12-75 mm, 15-70 mm, 20-50 mm, 25-30 mm. Even more in particular, the

thickness of each of the first cover member 204 and the second cover member 206 may be 5-15 mm.

The first cover member 204 and the second cover member 206 may have any suitable coating. For example, the first cover member 204 may be coated with a fire-retardant coating. This is because the first cover member 204 is in close proximity with a module-level power electronic (MPLE) 208 (to be described below).

According to a particular aspect, the first cover member 204 and/or the second cover member 206 may be coated with a vapour barrier layer to improve the waterproofing of the BIPV panel. The vapour barrier may prevent degradation of the BIPV panel performance due to condensation which may form in view of the differences in temperature between the indoors and the outdoor exterior wall.

The BIPV panel comprises a photovoltaic (PV) module 210. The PV module 210 may comprise any suitable PV device. For example, the PV device may be, but is not limited to, opaque photovoltaic device, semi-transparent photovoltaic device or a combination thereof. The PV module 210 may be paired with a module-level power electronic (MLPE) 208 for optimizing power generation of the PV module 210. The MLPE 208 may comprise, but is not limited to, an optimizer, micro-inverter or a combination thereof. The MLPE 208 may track the maximum power point of the BIPV panel 200 to maximise the power output. In this way, BIPV panels of various designs may be integrated into the building façade which therefore provides additional design flexibility. The MLPE 208 may also enable self-detection of anomaly and trigger shut-down procedures of the PV modules 210.

In particular, the MLPE 208 may be pre-wired and pre-embedded in the BIPV panel 200 so that when the BIPV panel 200 is ready for use, additional wiring may not be required. Also, at the installation site, persons without electrical experience may easily perform on-site installation of the BIPV panels. Accordingly, the BIPV panel 200 may comprise a wiring channel dimensioned to provide a passage for wiring bussing. In this way, the wiring will remain concealed on the exterior of the BIPV panel 200.

The PV module 210 may be encased in a frame structure 212. The frame structure 212 provides structural stability to the PV module 210. In addition to the frame structure 212, the BIPV panel 200 may also comprise a covering layer 214 to protect the surface

of the PV module 210. The covering layer 214 may be made of any suitable material and may have suitable properties. According to a particular aspect, the covering layer 214 may be transparent. The covering layer 214 may be made of glass.

The BIPV panel 200 may comprise an insulation layer. The insulation layer may be provided between the PV module 210 and the support structure 202. According to a particular aspect, the support structure 202 may be filled with insulation material to provide the insulation layer. The insulation layer prevents heat from the PV module 210 from impacting the indoor thermal environment of the building structure onto which the BIPV panel 200 may be provided. For example, in use, the temperature of the PV module may reach about 60-70°C and therefore the insulation layer may isolate the PV module 210 from the indoor thermal environment. The insulation layer may also act as a sound barrier.

The insulation layer may comprise filling of any suitable insulation material. For example, the insulation layer may comprise, but is not limited to, a filling of rock wool, glass wool, foam glass, perlite vermiculite, expanded clay, expanded polystyrene (EPS), extruded polystyrene (XPS), polyurethane (PUR), phenolic foam or a combination thereof.

The insulation layer may have a suitable thickness. For example, the thickness of the insulation layer may be 50-200 mm. In particular, the thickness of the insulation layer may be 55-175 mm, 60-150 mm, 65-100 mm, 70-85 mm, 75-80 mm. Even more in particular, the thickness of the insulation layer may be about 75 mm.

The BIPV panel 200 may further comprise a cavity layer 216. The cavity layer 216 may provide a natural ventilation layer behind the PV module 210, thereby helping in reducing the temperature of the PV module 210 when the PV module 210 is in use. Accordingly, the cavity layer 216 provides additional thermal insulation in addition to the insulation provided by the insulation layer.

The cavity layer 216 may have a suitable thickness. For example, the cavity layer 216 may comprise a thickness of 50-300 mm. In particular, the thickness of the cavity layer may be 55-250 mm, 60-200 mm, 75-175 mm, 80-150 mm, 100-125 mm. Even more in particular, the thickness of the insulation layer may be about 90 mm.

The BIPV panel 200 may further comprise water resistant barriers and air barriers such that there is water and air sealing of a wall formed from the BIPV panels.

According to a particular aspect, the BIPV panel may be prefabricated. Each BIPV panel may therefore be operated independently, with multiple BIPV panels being joined together to form a wall structure of a building. Each of the multiple BIPV panels may be joined to one another by any suitable method. In particular, each of the multiple BIPV panels may be joined together in an interlocking manner in which the BIPV panel may comprise a male or female junction to facilitate installation of adjacent BIPV panels. The BIPV panel may be adapted to form a male/female junction and prevent the direct infiltration of air and rainwater. A further waterproofing tap may be present on the inside of the BIPV panel, which effectively resists the infiltration of vapour.

In addition, an empty area may be provided at the four corners of the BIPV panel without adding insulation and boards. The corners may be used for connecting with neighbouring BIPV panels, as shown by the dash lines in Figure 1. After connection, the empty areas may be filled with insulation filling material. The insulation filling material may be as described above with respect to material suitable for filling the insulation layer.

Figure 4 provides an example of assembly process of the BIPV panel. In particular, the process begins with the assembly of the support structure (item 1 of Figure 4). Thereafter, the second cover member is assembled over one side of the support structure as shown as item 2 of Figure 4. The second cover member may additionally be provided with a vapour barrier layer. Following the assembly of the second cover member, a MLPE is then provided (item 3 of Figure 4). The insulation layer and the first cover member are then formed over the opposite side of the support structure as compared to the second cover member (see items 4 and 5 of Figure 4, respectively). Following that, the cavity layer is formed (item 6 of Figure 4). Next, a frame structure is provided (item 7 of Figure 4) to receive the PV module (item 8 of Figure 4). Lastly, the covering layer is provided over the PV module (item 9 of Figure 4).

In view of the above, it can be seen that the BIPV panel may be prefabricated and transported once it has been assembled to the site of the building where it is to be installed. At the building site, only an assembly of multiple BIPV panels will be required.

Whilst the foregoing description has described exemplary embodiments, it will be understood by those skilled in the technology concerned that many variations may be made without departing from the present invention.

Claims

1. A building integrated photovoltaic (BIPV) panel comprising:
 - a support structure for supporting the BIPV panel;
 - a photovoltaic (PV) module provided adjacent a surface of the support structure;
 - a module-level power electronic (MLPE) for optimizing power generation of the PV module;
 - an insulation layer provided between the PV module and the support structure; and
 - a cavity layer provided between the PV module and the support structure.
2. The BIPV panel according to claim 1, wherein the support structure is made of steel, aluminium, concrete, wood, or a combination thereof.
3. The BIPV panel according to claim 1 or 2, wherein the PV module comprises a photovoltaic device.
4. The BIPV panel according to claim 3, wherein the PV module comprises an opaque photovoltaic device, semi-transparent photovoltaic device or a combination thereof.
5. The BIPV panel according to any preceding claim, further comprising a frame structure for encasing the PV module.
6. The BIPV panel according to any preceding claim, further comprising a covering layer to protect the PV module surface.
7. The BIPV panel according to claim 6, wherein the covering layer is transparent.
8. The BIPV panel according to any preceding claim, further comprising a vapour barrier layer between the cavity layer and the insulation layer.

9. The BIPV panel according to any preceding claim, wherein each of the two opposing surfaces of the support structure is covered by a first cover member and a second cover member, respectively.

5 10. The BIPV panel according to any preceding claim, wherein the insulation layer comprises a filling of insulation material.

11. The BIPV panel according to any preceding claim, wherein the BIPV panel comprises a wiring channel dimensioned to provide a passage for wiring bussing.

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12. The BIPV panel according to any preceding claim, wherein the BIPV panel is prefabricated.