

AN ILLUMINATION SYSTEM

TECHNICAL FIELD

This invention relates generally to an illumination system.

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Background

Shelters, for example bus stops and walkways, are a common sight in urban environments. Since persons waiting in these shelters constitute an at least temporarily captive audience, advertisement displays of various types are often placed in these shelters. It is generally
10 desirable to provide a source of illumination in shelters for purposes of increasing visibility and security during hours of darkness and for illuminating advertising displays, transport schedules or other visual information therein. While shelters are usually disposed in urban areas where electrical power from street light systems and the like is readily available, providing illumination to transit shelters generally entails an unjustifiable expense. While
15 existing systems do provide for illumination of the shelter at night and can incidentally illuminate advertising and other display material therein in a secondary manner, they have found to be inadequate insofar as the exposed components of the lighting system are prone to theft and/or vandalism and the illumination level of lighting used are typically glaring to the eyes and has a higher level of power consumption. There is therefore a need for
20 addressing the foregoing problems.

Summary

In accordance with an aspect of the invention, there is disclosed an illumination system
25 comprising a power storage device, a photovoltaic generator in electrical communication with the power storage device for charging the power storage device and a light emitting structure being coupled to the power storage device and operable for providing illumination. The light emitting structure comprises a first substrate, a first electrode layer formed over the first substrate, a interpose layer formed over the first electrode layer, the interpose layer
30 comprising a light emitting material and a dielectric layer formed along the light emitting

material, and a second electrode layer formed over the interpose layer, the first electrode layer and the second electrode layer for providing electrical connection for the light emitting structure.

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Brief Description of the Drawings

FIG. 1 shows an exemplary system diagram of an illumination system in accordance with an aspect of the invention where a photovoltaic generator and a light emitting structure is electrically coupled with a power storage device;

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FIG. 2 shows an exemplary system diagram of FIG. 1 with a power controller inter-coupling the photovoltaic generator, the light emitting structure and the power storage device;

FIG. 3 shows a partial front sectional view of a portion of the illumination system of FIG. 1 being configured in a stacked module;

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FIG. 4 shows a partial front sectional view of a portion of the illumination system of FIG. 1 being configured in a planar module;

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FIG. 5 illustrates a front perspective view of the illumination system of FIG. 1 further comprising a shelter and a support structure configured as a bus stop;

FIG. 6 illustrates a front perspective view of the illumination system of FIG. 1 further comprising the shelter and the support structure configured as a bus stop of FIG. 5 with a separate stand;

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FIG. 7 shows an exemplary partial sectional view of the light emitting glass structure in accordance where a first conductive layer, an interpose layer, a conductive bus structure and a second conductive layer being formed between a first substrate and a second substrate; and

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FIG. 8 shows an exemplary partial sectional view of the light emitting glass structure of FIG. 7 with conductive paste being formed between the second conductive layer and the interpose layer;

Detailed Description

An exemplary embodiment of the present invention, an illumination system 20, is described hereinafter with reference to FIG. 1 to FIG. 8. The illumination system 20 comprises a power storage device 22, a photovoltaic generator 24 in electrical communication with the power storage device 22 for charging the power storage device 22, and a light emitting structure 100 being coupled to the power storage device 22 and operable for providing illumination.

The light emitting structure 100 comprises a first substrate 122, a first electrode layer 124, an interpose layer 126 and a second electrode layer 128. The interpose layer 126 comprises a light emitting material 130 and a dielectric layer 132. The first electrode layer 124 is formed over the first substrate 122 while the interpose layer 126 is formed over the first electrode layer 124. In one instance of forming the interpose layer 126 over the first electrode layer 124, the light emitting material 130 is first formed over the first electrode layer 124 prior to the dielectric layer 132 being formed over the light emitting material 130 for disposing the light emitting material 130 between the first electrode layer 124 and the dielectric layer 132. In another instance of forming the interpose layer 126 over the first electrode layer 124, the dielectric layer 132 is first formed over the first electrode layer 124 prior to the light emitting material 130 being formed over the dielectric layer 132 for disposing the dielectric layer 132 between the first electrode layer 124 and the light emitting material 130.

The second electrode layer 128 is disposed over the interpose layer 126 by forming the second electrode layer 128 on the interpose layer 126. Alternatively, the light emitting glass structure further comprises a second substrate 134 with the second electrode layer 128 being first formed on the second substrate 134 before the second electrode layer 128 is coupled to the interpose layer 126 for disposing the second electrode layer 128 between the first substrate 122 and the second substrate 134. The first electrode layer 124 and the second electrode layer 128 are providing electrical connection for the light emitting structure 100.

Preferably, the illumination system 20 further comprises a power controller 26 in electrical communications with the photovoltaic generator 24, the power storage device 22 and the light emitting structure 100. The power controller 26 is for sensing the level of charge of the power storage device 22 and the level of power being produced by the photovoltaic generator 24 and to control charging of the power storage device 22 and the illumination of the light emitting structure 100 in response thereto. Preferably, the photovoltaic generator 24 comprises at least one amorphous silicon photovoltaic device while the power storage device 22 comprises at least one of batteries and super-capacitors.

The photovoltaic generator 24 defines a preferred charge face 28 for exposure to sunlight for converting the sunlight into electrical flow. The light emitting structure 100 preferably has at least one illumination face 30 that is illuminated when electrical power is provided thereto.

In one exemplary configuration, the photovoltaic generator 24 is disposed over the light emitting structure 100 for forming a stacked module 32 having a first face 34 and a second face 36 outwardly opposing the first face 34. The photovoltaic generator 24 is positioned so that the charge face 28 substantially forms or is adjacent at least a portion of the first face 34 for capturing sunlight therefrom, and the light emitting structure 100 being positioned so that the illumination face 30 substantially forms or is adjacent at least a portion of the second face 36 for illumination thereof. For this configuration, the light emitting structure 100 may be spatially displaced from the photovoltaic generator 24 in the stacked module 32 to form a void therebetween. Alternatively, the void may accommodate a support structure 37 for structurally supporting both the light emitting structure 100 and the photovoltaic generator 24 to.

In another exemplary configuration, the photovoltaic generator 24 is disposed adjacent the light emitting structure 100 along a plane for forming a planar module 38 having a first face 40 and a second face 42 outwardly opposing the first face 40. The photovoltaic generator 24, specifically the charge face 28 thereof, is positioned for forming or being adjacent at least a

portion of the first face 40 for capturing sunlight therefrom, and the light emitting structure 10, specifically the illumination face 30 thereof, is positioned for forming at least a portion of the second face 42 for illumination thereof.

- 5 The illumination system 20 further comprises a roof structure 44 spatially displaceable from the ground 46 or a surface and is shaped for providing shelter. At least one of the photovoltaic generator 24 and the light emitting structure 100 is one of coupled with, contained within and formed integral with the roof structure 44. Cavities may be formed within the roof structure 44 to accommodate one or both of the photovoltaic generator 24 and the light emitting structure 100. Preferably, access to the cavity and one or both of the photovoltaic generator 24 and the light emitting structure 100 contained therein is via one or more openings that may be covered with at least one transparent window, for example a glass, plastic, perspex or the like transparent and substantially rigid panel for weather sealing the openings to the cavity without optically occluding the one or both of the photovoltaic generator 24 and the light emitting structure 100 contained in the cavity.

Preferably, the photovoltaic generator 22, specifically the charge face 28 thereof, is substantially upwardly facing while the light emitting structure 100, specifically the illuminating face 30 thereof, is one of downwardly facing and sideward facing when configured with the roof structure 44. The illumination system 20 further comprises a support structure 48 extending from the ground 46 whereto the roof structure 44 is coupled for spatially displacing the roof structure 44 from the ground 46.

When the roof structure 44 and the support structure 48 are configured as a fixed or mobile shelter structure for functioning as, for example, part of a walkway, bus-stop, tram-stop or train stop the photovoltaic generator 22 will be coupled to the roof structure 44 with the charge face 28 thereof being substantially upward facing. More than one of the photovoltaic generator 22, also typically referred to as a solar panel, may be employed and coupled to the roof structure 44 in similar orientations. The light emitting structure 100 will be coupled to the roof structure 44 with the illuminating face 30 thereof being downward facing. In some

implementations, the light emitting structure 100 can have two outwardly facing illuminating faces 30 and will be disposed to have one of the illuminating face 30 being upwardly facing while the other of the illuminating faces 30 being downwardly facing. Similarly, more than one of the light emitting structures 100 may be employed and coupled
5 to the roof structure 44 in similar orientations.

Additionally or alternatively, the light emitting structure 100 may be coupled to the support structure 48, a separate stand 50, or both in an orientation with the on woe more illuminating face 30 being laterally facing and being substantially perpendicular the ground 46. In this
10 orientation, the light emitting structure 100 is used to not only provide illumination, but to also provide back lighting for signage, billboards, advertisements and graphics. Each or either of the support structure 48 and the separate stand may be employed to accommodate one or more of the stacked module 32 in the lateral configuration.

15 The power storage device 22 and the power controller 26 may be accommodated in the roof structure 44, the support structure 48 or a standalone control panel. The power controller 26 may be further coupled to an external power supply, for example the public power grid, so that power may be drawn therefrom should the power storage device 22 have insufficient charge. The power controller 26 may have a user-interface for use in intervening or over-
20 riding the programmed or automatic operation of the power controller 26 and to obtain data therefrom. In addition, the power controller 26 may enable wired and/or wireless access thereto, for example via GPS, or through a smart device using Wifo or Bluetooth, for enabling communication therewith.

25 Preferably, the light emitting structure 100 further comprises conductive adhesive 136 being formed or deposited over the interpose layer 126 prior to and enabling the second electrode layer 128 to be coupled to the interpose layer 126 to thereby dispose the conductive adhesive 136 substantially between the interpose layer 126 and the second electrode layer 124.

The light emitting structure 100 further comprises a conductive bus structure 138 being formed on the first electrode layer 124. The conductive bus structure 138 is formed spatially displaced from the interpose layer 126.

- 5 Preferably, the conductive adhesive 136 is formed from a silver filled polymer, for example, silver filled AVA polymer. As the interpose layer 126 can be formed with various shapes and patterns over the first electrode layer 124, the conductive adhesive 136 may serve to laminate the interpose layer 126 and function to fill the edges of and cavities defined by the various shapes formed thereby.

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- Preferably, each of the first substrate 122 and the second substrate 134 is a glass substrate of the like rigid structure that is either optically transparent or opaque. Further preferably, the dielectric layer 132 is formed from ceramic paste or barium titanate composite, and the light emitting material 130 is phosphor paste or doped zinc sulfide. Each of the first electrode
- 15 layer 124 and the second electrode layer 128 is formed from conductive oxides, such as indium tin oxide or zinc oxide, from conductive polymers or from silver paste. Preferably, each of the first electrode layer 124, the interpose layer 126, the second electrode layer 128 and the conductive adhesive 136 is formed by one of jet spray printing and screen printing. In this manner, the light emitting glass structure 100 is provided for use in displays,
- 20 advertising, or other visual display applications.

- One or both of the first electrode layer 124 and the second electrode layer 128 may be formed or provided as a meshed-patterned electrode to reduce cost and integration of the light emitting material 138 or interpose layer 126 therewith for increased usability. The
- 25 patterned the light emitting material 138 or interpose layer 126 may be encapsulated within the manufacturing thereof. Advantageously, the patterned the light emitting material 138 or interpose layer 126 may be encapsulated such that the printed light emitting glass structure has increased lifetime and mechanical robustness.

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Embodiments of the present printed light emitting structure 100 can provide large area lighting, large area signage, or large area display, under both indoor and outdoor conditions while preserving the moonlight lighting and low power consumption nature of the light emitting structure 100 utilised in the illumination system 20. While several exemplary
5 embodiments have been presented in the foregoing detailed description of the invention, it should be appreciated that a vast number of variations exist.

Aspects of particular embodiments of the present disclosure address at least one aspect, problem, limitation, and/or disadvantage associated with illumination systems. While
10 features, aspects, and/or advantages associated with certain embodiments have been described in the disclosure, other embodiments may also exhibit such features, aspects, and/or advantages, and not all embodiments need necessarily exhibit such features, aspects, and/or advantages to fall within the scope of the disclosure. It will be appreciated by a person of ordinary skill in the art that several of the above-disclosed structures, components,
15 or alternatives thereof, can be desirably combined into alternative structures, components, and/or applications. In addition, various modifications, alterations, and/or improvements may be made to various embodiments that are disclosed by a person of ordinary skill in the art within the scope of the present disclosure, which is limited only by the following claims.

Claims

1. An illumination system comprising:

a power storage device;

- 5 a photovoltaic generator in electrical communication with the power storage device for charging the power storage device;

a light emitting structure being coupled to the power storage device and operable for providing illumination, the light emitting structure comprising:

a first substrate;

- 10 a first electrode layer formed over the first substrate;

a interpose layer formed over the first electrode layer, the interpose layer comprising a light emitting material and a dielectric layer formed along the light emitting material;

- 15 a second electrode layer formed over the interpose layer, the first electrode layer and the second electrode layer for providing electrical connection for the light emitting structure; and

conductive adhesive formed over the interpose layer for coupling the second electrode layer thereto, the conductive adhesive being one of a silver filled polymer and silver filled AVA polymer.

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2. The illumination system of claim 1, the second electrode layer further being formed on a second substrate for interposing the first substrate and the second substrate.

3. The illumination system as in claim 1, further comprising:

- 25 a power controller in electrical communications with the photovoltaic generator, the power storage device and the light emitting structure, the power controller for sensing the level of charge of the power storage device and the level of power being produced by the photovoltaic generator and to control charging of the power storage device and the illumination of the light emitting structure in response thereto.
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4. The illumination system as in claim 1, the photovoltaic generator is disposed over the light emitting structure for forming a stacked module having a first face and a second face outwardly opposing the first face, the photovoltaic generator being
5 positioned for forming the first face for capturing sunlight therefrom, and the light emitting structure being positioned for forming the second face for illumination thereof.
5. The illumination system as in claim 4, the light emitting structure being spatially
10 displaced from the photovoltaic generator in the stacked module.
6. The illumination system as in claim 1, the photovoltaic generator is disposed adjacent the light emitting structure along a plane for forming a planar module having a first face and a second face outwardly opposing the first face, the
15 photovoltaic generator being positioned for forming at least a portion of the first face for capturing sunlight therefrom, and the light emitting structure being positioned for forming at least a portion of the second face for illumination thereof.
7. The illumination system as in claim 1, further comprising:
20 a roof structure being spatially displaceable from the ground and being shaped for providing shelter, at least one of the photovoltaic generator and the light emitting structure being one of coupled with, contained within and formed integral with the roof structure.
- 25 8. The illumination system as in claim 7, the roof structure having at least one transparent window for exposing the at least one of the photovoltaic generator and the light emitting structure contained therein.

9. The illumination system as in claim 7, the photovoltaic generator being substantially upwardly facing and the light emitting structure being substantially one of downwardly facing and sideward facing when configured with the roof structure.
- 5 10. The illumination system as in claim 7, further comprising a support structure extending from the ground whereto the roof structure is coupled for spatially displacing the roof structure from the ground.
11. The illumination system as in claim 2, at least one of the first substrate and the
10 second substrate being made from one of glass and plastic.
12. The illumination system as in claim 1, one of the light emitting material and dielectric layer being formed on the first electrode and interposing the first electrode and the other thereof.
- 15 13. The illumination system as in claim 1, the light emitting material being formed over the first electrode layer and the dielectric layer formed over the light emitting material.
- 20 14. The illumination system as in claim 1, further comprising:
a conductive bus structure formed on the first electrode layer and spatially displaced from the interpose layer.
15. The illumination system as in claim 1, the conductive adhesive further for laminating
25 the interpose layer.
16. The illumination system as in claim 1, the dielectric layer being formed from ceramic paste, the light emitting material being phosphor paste, the first electrode layer being formed from indium tin oxide and the second electrode layer being
30 formed from silver paste.

AN ILLUMINATION SYSTEM

5 **Abstract**

Disclosed herein is an illumination system comprising a power storage device, a photovoltaic generator in electrical communication with the power storage device for charging the power storage device and a light emitting structure being coupled to the power storage device and operable for providing illumination. The light emitting structure
10 comprises a first substrate, a first electrode layer formed over the first substrate, a interpose layer formed over the first electrode layer, the interpose layer comprising a light emitting material and a dielectric layer formed along the light emitting material, and a second electrode layer formed over the interpose layer, the first electrode layer and the second electrode layer for providing electrical connection for the light emitting structure.

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20 **Figure 1**