

LIGHT EMITTING GLASS STRUCTURE

TECHNICAL FIELD

5 This invention relates generally to a light emitting glass structure and a method for forming thereof.

Background

Building owners, architects and passers-by have always been fascinated not only by façade lighting and the splendor it creates, but have found it useful for conveying message, creating
10 attention and portraying a positive message. There are different ways to illuminate a building, either on opaque or glass surfaces. However, illuminating a glass surface is not as easy as compared to opaque surfaces.

Glass surfaces are typically lighted up with third party light sources either with light
15 emitting diodes (LED) bulbs or lamps from other traditional lighting media. As in most cases, glass and lights operate as two distinct functional elements, each with their own function with high sunken cost. The combination of glass and light into a single media of light emitting glass provides the cost advantage of providing a functional glass material while emitting soft glowing light directly from its surfaces. Therefore, there exists a need
20 for a scalable, easily manufacturable large area forming method for light emitting glass structures.

Summary

In accordance with a first aspect of the invention, there is disclosed a light emitting glass
25 structure comprising a first substrate, a first electrode layer formed over the first substrate, a interpose layer formed over the first electrode, and a second electrode layer formed on a second substrate for interposing the first substrate and the second substrate. The interpose layer comprises a light emitting material and a dielectric layer formed along the light emitting material, the first electrode layer and the second electrode layer for providing
30 electrical connection for the light emitting glass structure.

In accordance with a second aspect of the invention, there is disclosed a light emitting glass structure forming method comprising forming a first electrode layer formed over a first substrate, forming interpose layer formed over the first electrode, and forming a second electrode layer over the interpose layer. The interpose layer comprising a light emitting material and a dielectric layer formed along the light emitting material.

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Brief Description of the Drawings

FIG. 1 shows an exemplary partial sectional view of a light emitting glass structure in accordance with one aspect of the invention 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;

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FIG. 2 shows an exemplary partial sectional view of the light emitting glass structure of FIG. 1 with conductive paste being formed between the second conductive layer and the interpose layer;

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FIG. 3 shows an exemplary process flow diagram of a light emitting glass structure forming method for forming at least a portion of the light emitting glass structure of FIG. 1 in accordance with another aspect of the invention; and

FIG. 4 shows an exemplary process flow diagram of FIG. 3 with steps for forming the conductive paste of FIG. 2.

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Detailed Description

An exemplary embodiment of the present invention, a light emitting glass structure 20 and a light emitting glass structure forming method 100 is described hereinafter with reference to
5 FIG. 1 to FIG. 4.

The light emitting glass structure 20 comprises a first substrate 22, a first electrode layer 24, a interpose layer 26 and a second electrode layer 28. The interpose layer 26 comprises a light emitting material 30 and a dielectric layer 32. In accordance with the light emitting
10 glass structure forming method 100, the first electrode layer 24 is formed over the first substrate 22 in a step 110 while the interpose layer 26 is formed over the first electrode layer 24 in a step 112. In one instance of forming the interpose layer 26 over the first electrode layer 24, the light emitting material 30 is first formed over the over the first electrode layer 24 prior to the dielectric layer 32 being formed over the light emitting material 30 for
15 disposing the light emitting material 30 between the first electrode layer 24 and the dielectric layer 32. In another instance of forming the interpose layer 26 over the first electrode layer 24, the dielectric layer 32 is first formed over the over the first electrode layer 24 prior to the light emitting material 30 being formed over the dielectric layer 32 for disposing the dielectric layer 32 between the first electrode layer 24 and the light emitting
20 material 30.

Following the step 112, the second electrode layer 28 is disposed over the interpose layer 26 in a step 114 by forming the second electrode layer 28 on the interpose layer 26. Alternatively, the light emitting glass structure further comprises a second substrate 34 with
25 the second electrode layer 28 being first formed on the second substrate 34 in a step 116 before the second electrode layer 28 is coupled to the interpose layer 26 in a step 118 for disposing the second electrode layer 28 between the first substrate 22 and the second substrate 34. The first electrode layer 24 and the second electrode layer 28 are providing electrical connection for the light emitting glass structure 20.

Preferably, the light emitting glass structure 20 further comprises conductive adhesive 36 being formed or deposited over the interpose layer 26 in a step 120 prior to and enabling the second electrode layer 28 to be coupled to the interpose layer 26 to thereby dispose the conductive adhesive 36 substantially between the interpose layer 26 and the second electrode layer 24.

The light emitting glass structure 20 further comprises a conductive bus structure 38 being formed on the first electrode layer 24 in a step 122. The conductive bus structure 38 is formed spatially displaced from the interpose layer 26.

Preferably, the conductive adhesive 36 is formed from a silver filled polymer, for example, silver filled AVA polymer. As the interpose layer 26 can be formed with various shapes and patterns over the first electrode layer 24, the conductive adhesive 36 may serve to laminate the interpose layer 26 and function to fill the edges of and cavities defined by the various shapes formed thereby.

Preferably, each of the first substrate 22 and the second substrate 34 is a glass substrate of the like rigid structure that is either optically transparent or opaque. Further preferably, the dielectric layer 32 is formed from ceramic paste or barium titanate composite, and the light emitting material 30 is phosphor paste or doped zinc sulfide. Each of the first electrode layer 24 and the second electrode layer 28 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 24, the interpose layer 26, the second electrode layer 28 and the conductive adhesive 36 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, advertising, or other visual display applications.

One or both of the first electrode layer 24 and the second electrode layer 28 may be formed or provided as a meshed-patterned electrode to reduce cost and integration of the light emitting material 38 or interpose layer 26 therewith for increased usability. The patterned

the light emitting material 38 or interpose layer 26 may be encapsulated within the manufacturing thereof. Advantageously, the patterned the light emitting material 38 or interpose layer 26 may be encapsulated such that the printed light emitting glass structure has increased lifetime and mechanical robustness.

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In an example of implementation of the light emitting glass structure forming method 100, operating temperatures of substantially between 20 °C to 30 °C and operating humidity of substantially between 39% to 76% are preferred. Prior to the utilization of any of the first substrate 22 and the second substrate 34, each of the first substrate 22 and the second
10 substrate 24 needs to be prepared by first being cut into the required size, being heated in an oven at 140°C for 1 hour and then being cooled, preferably in the same oven, until the temperature of the oven reaches 60°C.

For each of the first electrode layer 24 and the second electrode layer 28, silver paste is
15 preferably screen printed at 40mm/s to 70mm/s at a pressure of 0.24MPa before being cured in an oven for 130°C for 20mins and subsequently inspected for broken traces, unintended voids and that a thickness of 6-8µm for the respective one of the first electrode layer 24 and the second electrode layer 28 has been achieved.

20 For the dielectric layer 32, dielectric material is preferably screen printed at 40mm/s to 70mm/s at a pressure of 0.24MPa before being cured in an oven for 130°C for 20mins and subsequently inspected for unintended voids and that a thickness of 20µm for the dielectric layer 32 has been achieved. For the light emitting material 30, dielectric material is
25 preferably screen printed at 40mm/s to 70mm/s at a pressure of 0.24MPa before being cured in an oven for 130°C for 20mins and subsequently inspected for unintended voids and that a thickness of 30µm for the light emitting material 30 has been achieved. Inspection for voids and broken traces are preferably performed using one or both of a light box and an optical microscope.

Embodiments of the present printed light emitting glass structure 20 can provide large area lighting, large area signage, or large area display, under both indoor and outdoor conditions. While several exemplary embodiments have been presented in the foregoing detailed description of the invention, it should be appreciated that a vast number of variations exist.

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Aspects of particular embodiments of the present disclosure address at least one aspect, problem, limitation, and/or disadvantage associated with light emitting glass structures and a method for forming thereof. While 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, 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.

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Claims

1. A light emitting glass structure comprising:
 - a first substrate;
 - 5 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
 - 10 a second electrode layer formed on a second substrate for interposing the first substrate and the second substrate, the first electrode layer and the second electrode layer for providing electrical connection for the light emitting glass structure.
- 15 2. The light emitting glass structure 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.
- 20 3. The light emitting glass structure 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.
4. The light emitting glass structure as in claim 1, further comprising:
 - a conductive bus structure formed on the first electrode layer and spatially displaced from the interpose layer.
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5. The light emitting glass structure as in claim 1, further comprising:
 - conductive adhesive formed over the interpose layer for coupling the second electrode layer thereto.

6. The light emitting glass structure as in claim 5, the conductive adhesive being a silver filled polymer.
7. The light emitting glass structure as n claim 6, the silver filled polymer being silver filled AVA polymer.
8. The light emitting glass structure as in claim 5, the conductive adhesive further for laminating the interpose layer.
9. The light emitting glass structure 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 formed from silver paste.
10. The light emitting glass structure as in claim 1, each of the first substrate and the second substrate being glass.
11. A light emitting glass structure forming method comprising:
 - forming a first electrode layer formed over a first substrate;
 - forming interpose layer formed over the first electrode, the interpose layer comprising a light emitting material and a dielectric layer formed along the light emitting material, and
 - forming a second electrode layer over the interpose layer.
12. The light emitting glass structure forming method as in claim 11, forming the second electrode layer over the interpose layer comprising:
 - forming the second electrode layer on a second substrate; and
 - electrically coupling the second electrode layer to the interpose layer to thereby disposing the second electrode between the first substrate and the second substrate.

13. The light emitting glass structure forming method as in claim 12, further comprising:
forming a conductive adhesive formed over the interpose layer for enabling
electrical coupling of the second electrode layer thereto.

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14. The light emitting glass structure forming method as in claim 12, each of the first
electrode layer, the interpose layer, the second electrode layer and the conductive
adhesive being formed by one of jet spray printing and screen printing.

- 10 15. The light emitting glass structure forming method as in claim 11, 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 16. The light emitting glass structure forming method as in claim 11, the light emitting
material being formed over the first electrode layer and the dielectric layer formed
over the light emitting material.

- 20 17. The light emitting glass structure forming method as in claim 11, further comprising:
forming a conductive bus structure on the first electrode, the conductive bus
structure being spatially displaced from the interpose layer.

- 25 18. The light emitting glass structure forming method as in claim 11, 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 formed from silver paste.

19. The light emitting glass structure forming method as in claim 12, each of the first
substrate and the second substrate being glass.

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