

HEATED GLASS STRUCTURE

TECHNICAL FIELD

This invention relates generally to a heated glass structure and a method for forming thereof.

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Background

Application of heated glass has seen changes over the years is, for example, in commercial glass panels where a tin oxide coating is disposed on one of the interior surfaces of a glass panel where an electric current is dissipated in the tin oxide to provide heat to raise the glass temperature above the dew point. However, non-uniform coatings and traditional electrical control methods result in wasted energy, produce hot and cold spots on the glass, and can result in safety hazards should the glass break and expose the current-carrying film. This approach could benefit from control opportunities that exist using the current state of control technology. This problem is further expounded when the heated glass is implemented in a residential or small space setting in constant close proximity to people when in use. Therefore, there exists a need for an improved heated glass structure.

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Summary

In accordance with a first aspect of the invention, there is disclosed a heated glass structure comprising a first substrate that is a conductive substrate, a first conductive lead formed on the first substrate, a conductive layer formed over the first substrate where the first conductive lead is spatially displaced from the conductive layer. The heated glass structure further comprises a second conductive lead disposed over the conductive layer, a resin layer extending over the conductive layer with the second conductive lead interposing the conductive layer, and a second substrate disposed over the resin layer with the resin layer interposing the first substrate and the second substrate.

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In accordance with a second aspect of the invention, there is disclosed a heated glass structure forming method comprising forming a conductive layer formed over a first

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substrate, the first substrate being a conductive substrate, forming a first conductive lead formed on the first substrate, the first conductive lead being spatially displaced from the conductive layer, forming a second conductive lead disposed over the conductive layer, forming a resin layer over the first substrate, the resin layer extending over the conductive layer with the second conductive lead interposing the conductive layer, and disposing a second substrate disposed over the resin layer with the resin layer interposing the first substrate and the second substrate.

Brief Description of the Drawings

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

FIG. 2 shows an exemplary process flow diagram of a heated glass structure forming method for forming at least a portion of the heated glass structure of FIG. 1 in accordance with another aspect of the invention.

Detailed Description

An exemplary embodiment of the present invention, a heated glass structure 20 and a heated glass structure forming method 100 is described hereinafter with reference to FIG. 1 to FIG. 2.

The heated glass structure 20 comprises a first substrate 22. Specifically, the first substrate 22 is a conductive substrate. The heated glass structure 20 further comprises a first conductive lead 24 formed over the first substrate 22 and a conductive layer 28 formed over the first substrate 22. The first conductive lead 24 is spatially displaced from the conductive layer 28. Preferably, the conductive layer is formed by one of jet spray printing, screen printing, magnetron sputtering and chemical vapour deposition. The conductive layer 28 can be formed with various shapes and patterns, for example in a grid pattern, as interleaving fingers or concentric or spiralling circular or rectilinear lines.. Hence, in this manner, the heated glass structure 20 for both functional and decorative purposes on walls, on furniture, in changing rooms and in washrooms.

The heated glass structure 20 further comprises a second conductive lead 36 disposed over the conductive layer 28, a resin layer 40 extending over the conductive layer 28 with the second conductive lead 36 interposing the conductive layer 28 and the resin layer 40, and a second substrate 42 disposed over the resin layer 40 with the resin layer 40 interposing the first substrate 22 and the second substrate 42.

Preferably, the first substrate 22 is a conductive glass substrate, the second substrate 42 being a glass substrate, and the resin layer 40 is a polyvinyl butyral (PVB) layer. Each of the first substrate 22 and the second substrate 42 is a rigid structure that is either optically transparent or opaque. Preferably, each of the first conductive lead 24 and the second conductive lead 36 is a printed conductive structure, layer or strip. Alternatively, each of the first conductive lead 24 and the second conductive lead 36 is one of a copper sheet and a copper plate structure. Preferably, the conductive layer 28 is formed from conductive oxides, such as at least one of conductive zinc oxide, indium tin oxide and silver paste.

The conductive layer 28 may be encapsulated during the manufacturing thereof. Advantageously, the conductive layer 28 may be encapsulated with PVB so that the printed heated glass structure 20 has increased lifetime and mechanical robustness.

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The heated glass structure 20 further comprises a backing layer 44 formed over the second substrate 42 and interposing the second substrate 42 and the resin layer 40. The backing layer 44 is formed from at least one of a reflective coating and a coloured glaze. Further, the reflective coating can be made from at least one of silver, tin, nickel, or chromium.

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The heated glass structure 20 further comprises a first connection line 46 having one end being bonded to the first conductive lead 24 and another end couplable to an electrical power source and a second connection line 50 having one end being bonded to the second conductive lead 36 and another end couplable to the electrical power source. Each of the first connection line 46 and the second connection line 50 may be electrical traces formed from printing of conductive material or can be an insulated wire, for example insulated copper wires.

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When implemented, the heated glass structure 20 further comprises at least one of a controller, a thermostat and a bi-metallic strip implement interfacing the electrical power source and each of the first conductive lead 24 and the second conductive lead 36 by and along at least one of the first connection line 46 and the second connection line 50 for controlling supply of electrical energy from the electrical power source to the conductive layer 28. The conductive layer 28 is dimensioned and adapted with the appropriate thickness so that sufficient heat can be generated thereby, when configured with the electrical power source, for sufficient heating of the second substrate 42, for example when the heated glass structure is implemented as a mirror attached to a door of cupboard, to substantially reduce fogging or frosting of the second substrate 42 with generating an overly large amount of heat that results in reduced heat dissipation of the heated glass structure 20.

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The use of the bi-metallic strip implement, disposed adjacent the first substrate 22, or the

use of simple sensors disposed adjacent the first substrate 22, enables the first substrate 22 and the second substrate 42 to be kept at a constant temperature.

5 The heated glass structure forming method 100 comprises a step 102 of forming the conductive layer 28 over the first substrate 22, a step 104 of forming the first conductive lead 24 to the first substrate 22, and a step 106 of forming the second conductive lead 36 to the conductive layer 28. The heated glass structure forming method 100 further comprises a step 108 of forming the resin layer 40 over the second conductive lead 36 and the second conductive lead 36 and a step 110 of disposing the second substrate 42 over the conductive
10 layer 28 to thereby dispose the resin layer 40 between the conductive layer 28 and the second substrate 42.

The step 102 of forming the conductive layer 28 over the first substrate 22 comprising a step 200 of forming the conductive layer 38 to extend substantially to or towards the edges 54 of
15 the first substrate 22, and a step 202 of stripping a portion of the conductive layer 38 along the edges 54 of the first substrate 22 to thereby form a border of exposed portion 56 around the conductive layer 38, with a preferable width of about 10mm to 30mm from the edge of the first substrate 22, to enable the forming of the first conductive lead 24 thereon.

20 Prior to the step 110 of disposing the second substrate 42 over the conductive layer 28, the heated glass structure forming method 100 further comprises a step 300 of forming the backing layer 44 over the second substrate 42 to thereby position the backing layer 44 between the second substrate 42 and the resin layer 40.

25 Prior to the utilization of any of the first substrate 22 and the second substrate 42, each of the first substrate 22 and the second substrate 42 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. Further, the first substrate 22 may be surface treated or coated to enable the first substrate 22 to be
30 electrically conductive.

The conductive layer 28 may be formed by screen printing silver paste 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 conductive layer 28 has been achieved.

Embodiments of the present printed heated glass structure 20 can provide heated mirrors or heated decorative glass panels or heated doors where the first substrate 22 functions as a backing to be affixed to a surface, an object or an article. The second substrate 42 is presented for viewing as a decorative surface or as a mirror, depending on the constituent of the backing layer 44. While exemplary embodiments have been presented in the foregoing detailed description of the invention, it should be appreciated that a vast number of variations exist.

The heated glass structure 20 employs solid-state chemistry and sputtering science,, material science, and ion sputtering science to generate heat energy from an AC or DC voltage. Due to its low power consumption, a wide operating voltage range can be utilised. Further, heated glass structure 20 can be made with reduced thickness which makes it installable even in the smallest of space. Further, the heated glass structure 20 can be made into any shape, pasted or suspended, which makes it easy to install and replace. This saves installation costs and reduces labor requirements for manufacture and installation.

The simple heated glass structure 20, when configured with the simple bi-metallic strip implement, allows for automatic constant temperature according to requirements during work use thereof, which completely avoids fire hazards related to heat accumulation.

As the main surface to be heated is that of the second substrate, the heat generated by the conductive layer 28 on the first substrate 22, when receiving electrical energy from the electrical power source, is transferred via the resin layer 40 to the second substrate 42. This

enables the heating of the second substrate 42, and consequent heating of the first substrate 22 to more uniformly dispersed and hence safer due to substantial reduction or elimination of hot spots on the second substrate 42 and the non-exposure of any part of the conductive layer 28, where the heat is generated, when the second substrate 42 is damaged or broken.

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Further, the construction of heated glass structure 22 allows it to be waterproof and shockproof. Hence, the heated glass structure 22 will not easily fail due to severe external impact and when used in harsh conditions. The heated glass structure 22 has resistant to low temperature, for example as low as 40°C and is suitable for various power supply voltage types, whether AC or DC. The expected usage life of the heated glass structure is more than 8000-25000 hours.

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Aspects of particular embodiments of the present disclosure address at least one aspect, problem, limitation, and/or disadvantage associated with heated 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 heated glass structure comprising:
 - a first substrate, the first substrate being a conductive substrate;
 - 5 a first conductive lead formed on the first substrate;
 - a conductive layer formed over the first substrate, the first conductive lead being spatially displaced from the conductive layer,
 - a second conductive lead disposed over the conductive layer;
 - a resin layer extending over the conductive layer with the second conductive
 - 10 lead interposing the conductive layer; and
 - a second substrate disposed over the resin layer with the resin layer interposing the first substrate and the second substrate.
2. The heated glass structure as in claim 1, further comprising a backing layer formed
 - 15 over the second substrate and interposing the second substrate and the resin layer, the backing layer being formed from at least one of a reflective coating and a coloured glaze.
3. The heated glass structure as in claim 2, the reflective coating being made from at
 - 20 least one of silver, tin, nickel, or chromium.
4. The heated glass structure as in claim 1, the first substrate being a conductive glass substrate and the second substrate being a glass substrate.
- 25 5. The heated glass structure as in claim 1, the resin layer being a polyvinyl butyral (PVB) layer.
6. The heated glass structure as in claim 1, each of the first conductive lead and the
 - 30 second conductive lead being one of a copper sheet, a copper plate structure and a printed conductive layer.

7. The heated glass structure as in claim 1, the conductive layer being indium tin oxide.
8. The heated glass structure as in claim 1, further comprising:
 - 5 a first connection line having one end being bonded to the first conductive lead and another end couplable to an electrical power source; and
 - a second connection line having one end being bonded to the second conductive lead and another end couplable to the electrical power source.
- 10 9. The heated glass structure as in claim 8, further comprising:
 - at least one of a controller, a thermostat and a bi-metallic strip implement interfacing the electrical power source and the first conductive lead and the second conductive lead by at least one of the first connection line and the second connection line for controlling supply of electrical energy from the electrical power source to
 - 15 the conductive layer.
10. A heated glass structure forming method comprising:
 - forming a conductive layer formed over a first substrate, the first substrate being a conductive substrate;
 - 20 forming a first conductive lead formed on the first substrate, the first conductive lead being spatially displaced from the conductive layer,
 - forming a second conductive lead disposed over the conductive layer;
 - forming a resin layer over the first substrate, the resin layer extending over the conductive layer with the second conductive lead interposing the conductive
 - 25 layer; and
 - disposing a second substrate over the resin layer with the resin layer interposing the first substrate and the second substrate.

11. The heated glass structure forming method as in claim 10, forming the conductive layer formed over the first substrate comprising:

forming the conductive layer to extend substantially towards the edges of the first substrate; and

- 5 stripping a portion of the conductive layer along the edges of the first substrate to thereby form a border of exposed portion around the conductive layer for the forming of the first conductive lead thereon.

12. The heated glass structure forming method as in claim 10, further comprising:

- 10 forming a backing layer over the second substrate and interposing the second substrate and the resin layer, the backing layer being formed from at least one of a reflective coating and a coloured glaze, the reflective coating being made from at least one of silver, tin, nickel, or chromium.

- 15 13. The heated glass structure forming method as in claim 10, the first substrate being a conductive glass substrate, the second substrate being a glass substrate, the resin layer being a polyvinyl butyral (PVB) layer, and the conductive layer being indium tin oxide

- 20 14. The heated glass structure forming method as in claim 10, each of the first conductive lead and the second conductive lead being one of a copper sheet, a copper plate structure and a printed conductive layer.

15. The heated glass structure forming method as in claim 10, further comprising:

- 25 bonding one end of a first connection line to the first conductive lead and coupling there other end thereof to an electrical power source; and

bonding one end of a second connection line to the second conductive lead and coupling there other end thereof to the electrical power source.