Claims

1.

A process for applying a low-e coating (15, 15', 17) to a glass container (10) having an external surface, which includes the steps of:

(a) preparing a low-e coating material including at least one of a metal or a transparent conductive oxide (TCO), wherein the metal is selected from the group consisting of silver, gold, and aluminum, and wherein the TCO is selected from the group consisting of SnO_2:Sb, SnO_2:F, In_2O_3:Sn, ZnO:F, ZnO:Al, and ZnO:Ga; and

(b) applying the coating material to the external surface of the glass container.

2.

The process set forth in claim 1 wherein the applying step (b) is carried out at a hot end of a glass container manufacturing process.

3.

The process set forth in claim 2 wherein the applying step (b) is carried out before the glass container is annealed in the glass container manufacturing process.

4.

The process set forth in claim 1 wherein the preparing step (a) includes the TCO and the applying step (b) includes chemical vapor deposition of the TCO to the glass container.

5.

The process set forth in claim 1 wherein the applying step (b) is carried out at a cold end of a glass container manufacturing process.

6.

The process set forth in claim 5 wherein the applying step (b) is carried out after the glass container is annealed in the glass container manufacturing process.

7.

The process set forth in claim 6 wherein the preparing step (a) includes the metal and the applying step (b) includes physical vapor deposition of the metal to the glass container.

8.

The process set forth in claim 5 wherein the at least one of a metal or a TCO is provided as particles in at least one of a polymer solution or silane solution.

9.

The process set forth in claim 8 including curing the at least one of a polymer or silane solution to form a transparent external coating on the container that reflects or otherwise attenuates infrared energy.

10.

The process set forth in claim 8 wherein the particles represent 1 to 10 % by weight of the coating material before it is applied to the containers.

11.

The process set forth in claim 8 wherein the particles represent 2 to 7 % by weight of the coating material before it is applied to the containers.

12.

The process set forth in claim 8 wherein the particles represent 3 to 5 % by weight of the coating material before it is applied to the containers.

13.

The process set forth in claim 1, wherein step (b) is carried out at an ambient temperature.

14.

The process set forth in claim 1, wherein step (b) is carried out at less than 150 degrees Fahrenheit.

15.

A glass container (10) made by the process set forth in claim 1.

Claims

1.

A process for forming a low-e coating on an exterior surface of a glass container, which includes the steps of:

(a) applying one or more color suppression layers to the exterior surface of the glass container, wherein the one or more color suppression layers consist of SnO_2 or SiO_2; and then

(b) applying a coating material including a transparent conductive oxide (TCO) to the exterior surface of the glass container to produce a stack of multiple layers on the exterior surface of the glass container, wherein the TCO is selected from the group consisting of SnO_2:Sb, SnO_2:F, In_2O_3:Sn, ZnO:F, ZnO:Al, and ZnO:Ga.

2.

The process set forth in claim 1 wherein steps (a) and (b) are carried out at a hot end of a glass container manufacturing process.

3.

The process set forth in claim 2 wherein steps (a) and (b) are carried out before the glass container is annealed in the glass container manufacturing process.

4.

The process set forth in claim 1 wherein the coating material including the TCO is applied to the exterior surface of the glass container in step (b) by chemical vapor deposition.

5.

The process set forth in claim 1 wherein steps (a) and (b) are carried out at a cold end of a glass container manufacturing process.

6.

The process set forth in claim 5 wherein steps (a) and (b) are carried out after the glass container is annealed in the glass container manufacturing process.

7.

The process set forth in claim 5 wherein the coating material applied to the exterior surface of the glass container in step (b) comprises a plurality of transparent conductive oxide (TCO) particles.

8.

The process set forth in claim 7 wherein the plurality of TCO particles are present in the coating material in an amount ranging between 1 wt. % and 10 wt. % before the coating material is applied to the exterior surface of the glass container.

9.

The process set forth in claim 7 wherein the plurality of TCO particles are present in the coating material in an amount ranging between 2 wt. % and 7 wt. % before the coating material is applied to the exterior surface of the glass container.

10.

The process set forth in claim 7 wherein the plurality of TCO particles are present in the coating material in an amount ranging between 3 wt. % and 5 wt. % before the coating material is applied to the exterior surface of the glass container.

11.

The process set forth in claim 7 wherein the (TCO) particles are dispersed in at least one of a polymer solution or a silane solution.

12.

The process set forth in claim 11 including, after step (b), curing the polymer solution or the silane solution to form a transparent coating on the exterior surface of the glass container that reflects or otherwise attenuates infrared energy.

13.

The process set forth in claim 1, wherein step (b) is carried out at an ambient temperature.

14.

The process set forth in claim 1, wherein step (b) is carried out at less than 150 degrees Fahrenheit.

15.

A glass container made by the process set forth in claim 1.

16.

The process set forth in claim 1, wherein step (a) includes:

applying a SnO_2 layer to the exterior surface of the glass container; and then

applying a SiO_2 layer to the exterior surface of the glass container.

17.

The process set forth in claim 1, wherein the one or more color suppression layers applied to the exterior surface of the glass container in step (a) have a total thickness in the range of 10 nm to 30 nm.

18.

The process set forth in claim 1, wherein a TCO layer is formed on the exterior surface of the glass container in step (b) that has a thickness in the range of 250 nm and 400 nm.

19.

The process set forth in claim 1, wherein the one or more color suppression layers applied to the exterior surface of the glass container in step (a) have a total thickness in the range of 10 nm to 30 nm.

20.

The process set forth in claim 1, wherein the stack of multiple layers produced on the exterior surface of the glass container in step (b) includes a SnO_2 layer, a SiO_2 layer, and a relatively thick transparent conductive oxide (TCO) layer, wherein the SnO_2 layer and the SiO_2 layer have a total thickness in the range of 10 nm to 30 nm and the TCO layer has a thickness in the range of 250 nm and 400 nm.