[0005] Optionally, the coated article can have a protective layer over at least a portion of the transparent conductive oxide layer. The protective layer includes a first protective film over at least a portion of the transparent conductive oxide layer, and a second protective film over at least a portion of the first protective film. The second protective film is the outer-most film in the coating stack, and includes a mixture of titania and alumina. Optionally, the protective layer can include a third protective film positioned between the first protective film and a second protective film.

[0005a] In one aspect, the present disclosure relates to a coated article comprising a substrate; a functional layer over at least a portion of the substrate, and a first protective film over at least a portion of the functional layer, wherein the first protective film comprises alumina, zirconia, silica or mixtures thereof, and a second protective film over at least a portion of the first protective film wherein the second protective film comprises titania and alumina, wherein the second protective film is an outermost film.

[0006] A method of forming a coated substrate includes providing a substrate. A transparent conductive oxide is identified and a thickness for the transparent conductive oxide is determined that will provide a sheet resistance of at least 5 Ω/□ and at most 25 Ω/□. An underlayer having a first underlayer material and a second underlayer material is identified. Thickness for the first underlayer and the second underlayer are determined that will provide the coated substrate with a color having an a* of at least -9 and at most 1, a b* of at least -9 and at most 1. The thicknesses of the two films in the underlayer are used to tune the color of the coated substrate. Since the color is impacted by the thickness of the transparent conductive oxide film, the color is tuned after the thickness of the transparent conductive oxide film is determined. The first underlayer film including the first underlayer material is applied over at least a

be positioned between the first protective film and the second protective film, or between the first protective film and the functional coating.

[0017] A method of making a coated article including providing a substrate. A functional coating is applied over at least a portion of the substrate. A first protective film is applied over at least a portion of the functional coating. A second protective film that includes titania and alumina is applied over at least a portion of the first protective film. Optionally, a third protective film is applied between the first protective film and the second protective film, or between the first protective film and the functional coating.

[0017a] In another aspect, the present disclosure relates to a method of protecting a functional coating comprising providing an article coated with a functional coating, applying a first protective film over at least a portion of the functional coating, wherein the first protective film comprises alumina, zirconia, silica or mixtures thereof; and applying a second protective film over at least a portion of the first protective film, wherein the second protective film comprises titania and alumina.

[0018] A method of reducing the absorption, resistance or emissivity of a transparent conductive oxide layer. A substrate is provided. A transparent conductive oxide layer is applied over at least a portion of the substrate in an atmosphere that comprises between 0 % and 2.0 % oxygen.

[0019] A coated article having reduced absorption, resistance or emissivity comprising a transparent conductive oxide layer made by the following steps. A substrate is provided. A transparent conductive oxide layer is applied over at least a portion of the substrate in an atmosphere that comprises between 0 % and 2.0 % oxygen.

BRIEF DESCRIPTION OF THE DRAWING(S)

[0020] The patent or application file contains at least one drawing executed in color. Copies of this patent or patent application publication with color drawing(s) will be provided by the Office upon request and payment of the necessary fee.

[0021] Figs. 1a, 1b, 1c and 1d are side views (not to scale) of coatings incorporating a feature of the invention;

[0022] Figs. 2a, 2b, 2c, 2d and 2e are side views of other coatings (not to scale) incorporating a feature of the invention;

[0023] Figs. 3a, 3b, 3c, 3d, 3e are side views of other coatings (not to scale) incorporating a feature of the invention;

THE INVENTION CLAIMED IS

1. A coated article comprising a substrate; a functional layer over at least a portion of the substrate, and a first protective film over at least a portion of the functional layer, wherein the first protective film comprises alumina, zirconia, silica or mixtures thereof, and a second protective film over at least a portion of the first protective film wherein the second protective film comprises titania and alumina, wherein the second protective film is an outermost film.

2. The coated article according to claim 1 further comprising a third protective film positioned between the first protective film and the second protective film.

3. The coated article of any of claims 1 or 2, wherein the second protective film comprises 35 to 65 weight percent titania.

4. The coated article according to claim 3, wherein the second protective film comprises 45 to 55 weight percent titania.

5. The coated article according to any one of the preceding claims, wherein the second protective film comprises 65 to 35 weight percent alumina.

6. The coated article according to claim 5, wherein the second protective film comprises 55 to 45 weight percent alumina.

7. The coated article of any one of the preceding claims wherein the first protective film comprises silica and alumina.

8. The coated article according to any one of the preceding claims, wherein the functional layer comprises a transparent conductive oxide layer selected from the group consisting of aluminum-doped zinc oxide, gallium-doped zinc oxide, and tin-doped indium oxide.

9. The coated article according to any one of claims 1 to 7, wherein the functional layer comprises a metal selected from the group consisting of silver, gold, palladium, copper or mixtures thereof.

10. The coated article of claim 2 or any of claims 3 to 9 as far as they depend on claim 2, wherein the third protective film comprises titania, alumina, zinc oxide, tin oxide, zirconia, silica or mixtures thereof.

11. A method of protecting a functional coating comprising providing an article coated with a functional coating, applying a first protective film over at least a portion of the functional coating, wherein the first protective film comprises alumina, zirconia,

silica or mixtures thereof; and applying a second protective film over at least a portion of the first protective film, wherein the second protective film comprises titania and alumina.

12. The method of claim 11 further comprising applying a third protective film over at least a portion of the first protective film, and positioned between the first protective film and the second protective film.

13. The method according to any one of claims 11 or 12, where the first protective film is in direct contact with the functional coating, the second protective film is in direct contact with the first protective film, and the second protective film is an outermost film on the article.