INSULATED GLAZING UNIT WITH CHAMFERED EDGE

ABSTRACT

[0001] The present disclosure relates to an electroactive device, such as an insulated glazing unit, and methods of manufacturing the device. Specifically, the insulated glazing unit can include a support lite with radiused corners and a substrate with chamfered edges. The substrate can include an electrochromic device.

BACKGROUND

[0002] An electrochemical device can include an electrochromic stack where transparent conductive layers are used to provide electrical connections for the operation of the stack. Electrochromic (EC) devices employ materials capable of reversibly altering their optical properties following electrochemical oxidation and reduction in response to an applied potential. The optical modulation is the result of the simultaneous insertion and extraction of electrons and charge compensating ions in the electrochemical material lattice. EC devices have a composite structure through which the transmittance of light can be modulated.

[0003] Electroactive devices are becoming more common in vehicular and industrial applications. However, the specific dimensions required for such applications can cause uniformity issues related to the spacing of the support substrate with relation to the electrochromic substrate. As such, improvements are needed to address electrochromic devices within vehicular and industrial applications.

DESCRIPTION

[0004] An insulated glazing unit, according to one embodiment can include the electrochromic lite (EC lite) and the support lite. The support lite can be shaped to include rounded or radiused corners. The EC lite can include an electrochemical device. For purposes of illustrative clarity, the electrochemical device is a variable transmission device. In one embodiment, the electrochemical device can be an electrochromic device. In another embodiment, the electrochemical device can be a thin-film battery. However, it will be recognized that the present disclosure is similarly applicable to other types of scribed electroactive devices, electrochemical devices, as well as other electrochromic devices with different stacks or film structures (e.g., additional layers). The device may include a substrate, a first transparent

conductor layer, a cathodic electrochemical layer, an anodic electrochemical layer, and a second transparent conductor layer.

[0005] In an implementation, the substrate can include a glass substrate, a sapphire substrate, an aluminum oxynitride substrate, or a spinel substrate. In another implementation, the substrate can include a transparent polymer, such as a polyacrylic compound, a polyalkene, a polycarbonate, a polyester, a polyether, a polyethylene, a polyimide, a polysulfone, a polysulfide, a polyurethane, a polyvinylacetate, another suitable transparent polymer, or a co-polymer of the foregoing. The substrate may or may not be flexible. In a particular implementation, the substrate can be float glass or a borosilicate glass and have a thickness in a range of 0.5 mm to 12 mm thick. The substrate may have a thickness no greater than 16mm, such as 12 mm, no greater than 10 mm, no greater than 8mm, no greater than 6mm, no greater than 5 mm, no greater than 3 mm, no greater than 2 mm, no greater than 1.5 mm, no greater than 1 mm, or no greater than 0.01 mm. In another particular implementation, the substrate 210 can include ultra-thin glass that is a mineral glass having a thickness in a range of 50 microns to 300 microns. In a particular implementation, the substrate may be used for many different electrochemical devices being formed and may referred to as a motherboard.

[0006] Transparent conductive layers can include a conductive metal oxide or a conductive polymer. Examples can include a tin oxide or a zinc oxide, either of which can be doped with a trivalent element, such as Al, Ga, In, or the like, a fluorinated tin oxide, or a sulfonated polymer, such as polyaniline, polypyrrole, poly(3,4-ethylenedioxythiophene), or the like. In another implementation, the transparent conductive layers can include gold, silver, copper, nickel, aluminum, or any combination thereof. The transparent conductive layers can include indium oxide, indium tin oxide, doped indium oxide, tin oxide, doped tin oxide, zinc oxide, doped zinc oxide, ruthenium oxide, doped ruthenium oxide and any combination thereof. The transparent conductive layers can have the same or different compositions. The transparent conductive layers can have a thickness between 10 nm and 600 nm. In one implementation, the transparent conductive layers can have a thickness between 200 nm and 500 nm. In one implementation, the transparent conductive layers can have a thickness between 320 nm and 460 nm. In one implementation the first transparent conductive layer can have a thickness between 10 nm and 600 nm. In one implementation, the second transparent conductive layer can have a thickness between 80 nm and 600 nm.

[0007] The electroactive device can include electrode layers, wherein one of the layers may be a cathodic electrochemical layer, and the other of the layers may be an anodic electrochromic layer (also referred to as a counter electrode layer). In one embodiment, the cathodic electrochemical layer is an electrochromic layer. The cathodic electrochemical layer can include an inorganic metal oxide material, such as WO_3, V_2O_5, MoO_3, Nb_2O_5, TiO_2, CuO, Ni_2O_3, NiO, Ir_2O_3, Cr_2O_3, Co_2O_3, Mn_2O_3, mixed oxides (e.g., W-Mo oxide, W-V oxide), or any combination thereof and can have a thickness in a range of 40 nm to 600 nm. In one implementation, the cathodic electrochemical layer can have a thickness between 100 nm to 400 nm. In one implementation, the cathodic electrochemical layer can have a thickness between 350 nm to 390 nm. The cathodic electrochemical layer can include lithium, aluminum, zirconium, phosphorus, nitrogen, fluorine, chlorine, bromine, iodine, astatine, boron; a borate with or without lithium; a tantalum oxide with or without lithium; a lanthanide-based material with or without lithium; another lithium-based ceramic material; or any combination thereof.

[0008] The anodic electrochromic layer can include any of the materials listed with respect to the cathodic electrochromic layer or Ta_2O_5, ZrO_2, HfO_2, Sb_2O_3, or any combination thereof, and may further include nickel oxide (NiO, Ni_2O_3, or combination of the two), and Li, Na, H, or another ion and have a thickness in a range of 40 nm to 500 nm. In one implementation, the anodic electrochromic layer can have a thickness between 150 nm to 300 nm. In one implementation, the anodic electrochromic layer can have a thickness between 250 nm to 290 nm. In some implementations, lithium may be inserted into at least one of the first electrode or second electrode.

[0009] In another implementation, the device may include a plurality of layers between the substrate and the first transparent conductive layer. In one implementation, an antireflection layer is between the substrate and the first transparent conductive layer. The antireflection layer can include SiO_2, NbO_2, and can be a thickness between 20 nm to 100 nm. The device may include at least two bus bars. The first bus bar can be electrically connected to the first transparent conductive layer and the second bus bar can be electrically connected to the second transparent conductive layer.

[0010] As seen in FIG. 1, the EC lite can be shaped to include chamfered corners. More specifically, the EC lite with the electrochromic device can be shaped to include chamfered corners. The chamfered corners can be seen in the x-y plane while on the z-plane the edge is

straight. In one embodiment, the corners of the EC lite can be cut prior to deposition of the electrochromic layers. In another embodiment, the corners of the EC lite can be cut after the deposition of the electrochromic layers. In one embodiment, the corners can be cut using a laser, such as a terrestrial laser scanning (TLS) instrument. In one embodiment the corners can be cut to include one or more straight sides. For example, a four sided device can be cut to include eight sides, as seen below in FIG. 1. In another embodiment, a four sided device can be cut to include between eight sides and thirty-two sides. In another embodiment, a three sided device may be cut to include between six sides and twenty-seven sides.

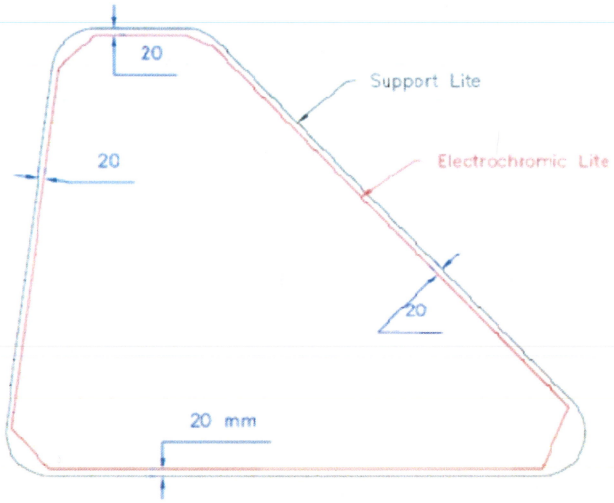

FIG. 1

[0011] In one embodiment, the edge of the EC light can be spaced apart from the support lite by a distance of between 5 mm and 30 mm. In another embodiment, the edge of the EC light can be spaced apart from the support lite by a distance of between 10 mm and 25 mm. In one embodiment, the greatest distance between the edge of the EC lite and the support lite is seen at the corners. In another embodiment, the distance between the edge of the EC lite and the edge of the support lite is less than the distance between the corner of the support lite and the corner of the EC lite. By chamfering the edges of the EC light, as seen in FIG. 1 above, the distance between the edge of the support lite and the edge of the EC lite can be decreased. As such, when installing the insulated glazing unit (IGU) within vehicles that require a rounded edge, the frame surrounding the IGU can cover any space between the EC lite and the support lite.