CLAIMS

~~*We claim:*~~

1. A method of fabricating an optical device comprising one or more material layers sandwiched between a first and a second conducting layer, the method comprising:

(i) receiving a substrate comprising the first conducting layer over its work surface;

(ii) removing a first width of the first conducting layer at the periphery of the substrate and along ~~from~~ between about 10% and about 90% of the perimeter of the substrate;

(iii) depositing said one or more material layers of the optical device and the second conducting layer such that they cover the first conducting layer and~~, where possible,~~ extend beyond the first conducting layer into the first width at the periphery of the substrate ~~about its perimeter~~;

(iv) removing a second width, narrower than the first width, of all the layers at the periphery of the substrate along ~~about~~ substantially the entire perimeter of the substrate, wherein the depth of removal is at least sufficient to remove the first conducting layer;

(v) removing at least one portion of the second transparent conducting layer and the one or more layers of the optical device thereunder, thereby revealing at least one exposed portion of the first conducting layer; and

(vi) applying a bus bar to said at least one exposed portion of the first transparent conducting layer,

wherein at least one of the first and second conducting layers is transparent.

2. The method of claim 1, wherein (ii) comprises removing the first width of the first conducting layer from between about 50% and about 75% around the perimeter of the substrate.

3. The method of claim 2, wherein said at least one exposed portion of the first conducting layer exposed is fabricated along the perimeter portion of the optical device proximate the side or sides of the substrate where the first conducting layer was not removed in (ii).

4. The method of claim 3, further comprising applying at least one second bus bar to the second conducting layer.

28. The method of claim 27, wherein (iii) is performed in an all vacuum integrated deposition apparatus.

29. The method of claim 28, further comprising depositing a vapor barrier layer on the second conducting layer prior to (iv).

30. The method of claim 12, wherein (ii) comprises removing the first width of the first conducting layer from two opposing sides at the perimeter of the substrate.

31. The method of claim 30, wherein said at least one exposed portion of the first conducting layer comprises a pair of exposed portions fabricated along the lengths of the opposing sides of the optical device from which the first width was not removed in (ii).

32. The method of claim 31, wherein (vi) comprises applying a bus bar to each of said pair of exposed portions of the first conducting layer.

33. The method of claim 32, wherein applying said at least one second bus bar to the second conducting layer comprises applying a pair of second bus bars, each of said pair of second bus bars on opposing lengths of the second conducting layer and over areas where the first conducting layer was removed in (ii).

34. The method of claim 33, wherein the optical device is an electrochromic device.

35. The method of claim 34, wherein the electrochromic device is all solid-state and inorganic.

36. The method of claim 35, wherein the substrate is float glass, tempered or untempered, and the first conducting layer comprises fluorinated tin oxide.

37. The method of claim 36, wherein (iii) is performed in an all vacuum integrated deposition apparatus.

38. The method of claim 37, further comprising depositing a vapor barrier layer on the second conducting layer prior to (iv).

~~39. The method of claim 12, wherein the substrate is circular or oval.~~

~~40. The method of claim 39, wherein the substrate is glass.~~

41. The method of claim 40, wherein said at least one second bus bar is applied to the second conducting layer proximate the side of the optical device opposite said at least one exposed portion of the first conducting layer.

42. The method of claim 41, wherein the optical device is an electrochromic device.

43. The method of claim 42, wherein the electrochromic device is all solid-state and inorganic.

44. The method of claim 43, wherein the substrate is float glass, tempered or untempered, and the first conducting layer comprises fluorinated tin oxide.

45. The method of claim 44, wherein (iii) is performed in an all vacuum integrated deposition apparatus.

46. The method of claim 45, further comprising depositing a vapor barrier layer on the second conducting layer prior to (iv).

47. The method of claim 39, wherein (ii) comprises removing the first width of the first conducting layer from two opposing portions about the perimeter of the substrate.

48. The method of claim 47, wherein said at least one exposed portion of the first conducting layer comprises a pair of exposed portions fabricated along the perimeter of the substrate on the portions of the optical device between the two opposing portions from which the first width was removed in (ii).

49. The method of claim 48, wherein (vi) comprises applying a bus bar to each of said pair of exposed portions of the first conducting layer.

50. The method of claim 49, wherein applying said at least one second bus bar to the second conducting layer comprises applying a pair of opposing second bus bars, each bus bar in one of the areas of the second conducting layer proximate the perimeter of the substrate between the pair of exposed portions of the first conducting layer.

51. The method of claim 50, wherein the optical device is an electrochromic device.

52. The method of claim 51, wherein the electrochromic device is all solid-state and inorganic.

~~53. The method of claim 52, wherein the substrate is float glass, tempered or untempered, and the first conducting layer comprises fluorinated tin oxide.~~

~~54. The method of claim 53, wherein (iii) is performed in an all vacuum integrated deposition apparatus.~~

~~55. The method of claim 54, further comprising depositing a vapor barrier layer on the second conducting layer prior to (iv).~~

~~56.~~39. The method of ~~any one of~~ claims 13~~, 25, 34, 42~~ ~~and 51~~, further comprising fabricating an IGU from the electrochromic device.

~~57.~~40. The method of claim ~~56~~39, wherein any remaining exposed areas of the first conducting layer are configured to be within the primary seal of the IGU.

~~58.~~41. The method of claim ~~57~~40, wherein all bus bars are also configured to be within the primary seal of the IGU.

~~59.~~42. The method of claim ~~56~~39, further including laminating the IGU with a flexible glass material.

~~60.~~43. The method of claim ~~59~~42, wherein the flexible glass material is Gorilla® Glass or Willow™ Glass.

~~61.~~44. The method of claim ~~43~~13, wherein the substrate is a flexible glass, about 0.5 mm or less in thickness, and the first conducting layer comprises tin oxide, optionally with indium and/or fluoride.

~~62. The method of claim 61, wherein (iii) is performed in an all vacuum integrated deposition apparatus.~~

~~63. The method of claim 62, further comprising depositing a vapor barrier layer on the second conducting layer prior to (iv).~~

~~64. The method of claim 61, wherein the flexible glass is Gorilla® Glass or Willow™ Glass.~~

~~65. The method of claim 62, wherein the flexible glass is Willow™ Glass.~~

66. The method of claim 65, further comprising laminating the EC device with either a rigid glass substrate or a flexible substrate.

67. The method of claim 66, wherein the flexible substrate is Gorilla® Glass or Willow™ Glass.

68. The method of any one of claims 1 – 67, wherein the substrate is a large area substrate and a plurality of the EC devices is fabricated thereon, followed by cutting the large area substrate to form the individual EC devices from the plurality of the EC devices.

69. The method of claim 68, wherein lamination is carried out on the large area format substrate prior to cutting.

70. An optical device comprising:

(i) a first conductor layer on a substrate, the first conductor layer comprising an area less than that of the substrate, the first conductor layer surrounded by a perimeter area of the substrate which is substantially free of the first conductor layer;

(ii) one or more material layers comprising at least one optically switchable material, said one or more material layers configured to be within the perimeter area of the substrate and co-extensive with the first conductor layer but for at least one exposed area of the first conductor layer, said at least one exposed area of the first conductor layer free of said one or more material layers; and

(iii) a second conductor layer on said one or more material layers, said second conductor layer being transparent and being co-extensive with the one or more material layers,

wherein the one or more material layers and the second conductor layer overhang the first conductor layer but for said at least one exposed area of the first conductor.

71. The optical device of claim 70, further comprising a vapor barrier layer coextensive with the second conductor layer.

72. The optical device of claim 70, further comprising an ion diffusion barrier between the substrate and the first conductor layer.

73. The optical device of claim 72, wherein the perimeter area of the substrate includes the ion diffusion barrier.

74. The optical device of claim 70, wherein said at least one optically switchable material is an electrochromic material.

75. The optical device of claim 74, wherein the substrate and the first conductor layer are also transparent.

76. The optical device of claim 75, wherein said at least one exposed area of the first conductor layer comprises a strip proximate the perimeter area of the substrate.

77. The optical device of claim 76, further including a first bus bar on and within the area of the strip.

78. The optical device of claim 77, further including a second bus bar on the second conductor layer, said second bus bar configured to be on a portion of the second conductor layer that does not cover the first conductor layer, said portion proximate the perimeter area and opposite the first bus bar.

79. The optical device of claim 78, wherein the first and second conductor layers and the one or more material layers are all solid-state and inorganic.

80. The optical device of claim 79, wherein the substrate is float glass, tempered or untempered, and the first conductor layer comprises fluorinated tin oxide.

81. The optical device of claim 80, wherein the substrate is registered with a second substrate in an IGU.

82. The optical device of claim 81, wherein any exposed areas of the first conductor layer are configured to be within the primary seal of the IGU.

83. The optical device of claim 82, wherein all bus bars are also configured to be within the primary seal of the IGU.

84. The optical device of claim 83, wherein the area of the second conductor layer that is not over the first conductor layer is also configured to be within the primary seal of the IGU.

85. The optical device of claim 84, the optical device being rectangular.

86. The optical device of claim 84, the optical device being round or oval.

87. The optical device of claim 84, the optical device being triangular.

88. The optical device of claim 85, wherein said at least one exposed area of the first conductor layer comprises a pair of strips, each strip of the pair of strips on opposing sides of the first conductor layer proximate the perimeter area of the transparent substrate.

89. The optical device of claim 88, further including a first pair of bus bars, each of the first pair of bus bars on and within the area of each strip of the pair of strips.

90. The optical device of claim 89, further including a second pair of bus bars on the second conductor layer, each of said second pair of bus bars configured to be on each of two portions of the second conductor layer that do not cover the first conductor layer, each of said two portions proximate the perimeter area and on opposing sides of the second conductor layer.

91. The optical device of claim 90, wherein the first and second conductor layers and the one or more material layers are all solid-state and inorganic.

92. The optical device of claim 91, wherein the substrate is float glass, tempered or untempered, and the first conductor layer comprises fluorinated tin oxide.

93. The optical device of claim 92, wherein the substrate is registered with a second substrate in an IGU.

94. The optical device of claim 93, wherein any exposed areas of the first conductor layer are configured to be within the primary seal of the IGU.

95. The optical device of claim 94, wherein all bus bars are also configured to be within the primary seal of the IGU.

96. The optical device of claim 95, wherein the area of the second conductor layer that is not over the first conductor layer is also configured to be within the primary seal of the IGU.

97. The optical device of claim 96, the optical device being rectangular.

98. The optical device of claim 96, the optical device being round or oval.

99. The optical device of claim 96, the optical device being triangular.

100. The optical device of any one of claims 70 - 99, which does not comprise a laser isolation scribe.

101. The optical device of any one of claims 70 - 99, which does not comprise an inactive portion of the optical device.

102. The optical device of any one of claims 70-99, wherein the substrate is a flexible glass.

103. The optical device of claim 102, wherein the flexible glass is Gorilla® Glass or Willow™ Glass.

104. The optical device of claim 103, wherein the IGU is laminated to a flexible glass.

105. The optical device of claim 104, wherein the flexible glass is Gorilla® Glass or Willow™ Glass.

106. A large area substrate laminate comprising:

a large area substrate comprising a plurality of all solid state and inorganic EC devices thereon; and

a strengthening pane,

wherein at least one of the large area substrate and the strengthening pane are a flexible glass that is 0.5 mm thick or less.

107. The large area substrate laminate of claim 106, wherein both the large area substrate and the strengthening pane are the flexible glass.

108. A method of fabricating an optical device, the method including tapering one or more edges of an underlying material layer prior to fabrication of overlapping layers thereon.

109. The method of claim 108, wherein the underlying material layer is the lower conductor layer and the optical device is an electrochromic device.

110. The method of claim 108, wherein tapering one or more edges of the lower conductor layer includes laser ablation.

111. The method of claim 110, wherein the laser is defocused so as to create smooth contours in the tapered edge portion.

112. An electrochromic device comprising a lower transparent conductor layer having one or more tapered edges.

113. The electrochromic device of claim 112, wherein the lower transparent conductor layer is between about 0.25 μm and about 1 μm thick.

114. The electrochromic device of claim 113, wherein the tapered portion of the one or more tapered edges is between about 0.25 μm and about 1000 μm wide.

115. A method of fabricating a bus bar pad expose, the method comprising laser ablation of overlying material down to an underlying conductor layer using varying laser ablation depths along a plurality of individual scribe lines during fabrication of the bus bar pad expose.

116. The method of claim 115, wherein each of the individual scribe lines, of the plurality of scribe lines, is scribed using a quasi top hat at the same fluence level.

117. The method of claim 115, wherein at least two individual scribe lines, of the plurality of scribe lines, is scribed using a different fluence level.

118. The method of claim 117, wherein the laser is configured to progressively remove more of the underlying conductor layer in each of the plurality of scribe lines, the ablation area of each scribe line is overlapped at least partially with the ablation area of the previous scribe line, and plurality of scribe lines are fabricated with least removal of underlying conductor layer nearest to the device stack and most removal of underlying conductive layer furthest from the device stack.

119. The method of claim 117, wherein the laser is configured to progressively remove more of the underlying conductor layer in each of the plurality of scribe lines,

the ablation area of said at least two scribe lines is overlapped at least partially with the ablation area, and plurality of scribe lines are fabricated with least removal of underlying conductor layer nearest to the device stack and most removal of underlying conductive layer furthest from the device stack.

120. The method of claim 117, wherein the laser is configured to progressively remove more of the underlying conductor layer in each of the plurality of scribe lines, the ablation area of each scribe line is overlapped at least partially with the ablation area of the previous scribe line, and plurality of scribe lines are fabricated with most removal of underlying conductor layer nearest to the device stack and least removal of underlying conductive layer furthest from the device stack.