



(51) International Patent Classification:

H01R 12/72 (2011.01) H01L 27/15 (2006.01)
H01R 12/73 (2011.01)

(21) International Application Number:

PCT/US2018/059922

(22) International Filing Date:

09 November 2018 (09.11.2018)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/587,121 16 November 2017 (16.11.2017) US

(71) Applicant: **CORNING INCORPORATED** [US/US];
One Riverfront Plaza, Corning, New York 14831 (US).

(72) Inventor: **MANLEY, Robert George**; 29 West Hill Road,
Vestal, New York 13850 (US).

(74) Agent: **ABLE, Kevin M.** et al.; Corning Incorporated, In-
tellectual Property Department, SP-TI-03-1, Corning, New
York 14831 (US).

(81) Designated States (*unless otherwise indicated, for every
kind of national protection available*): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP,
KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME,

MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,
SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every
kind of regional protection available*): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ,
UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,
MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,
TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: CONNECTORS FOR SUBSTRATES

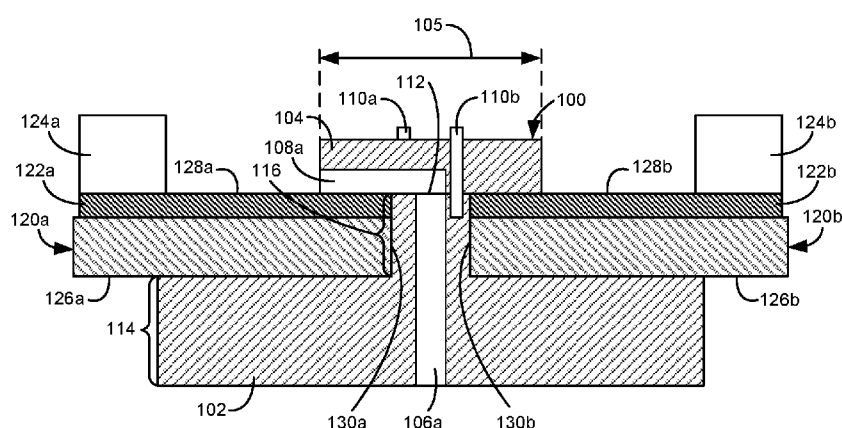


FIG. 1A

(57) Abstract: A connector including a first portion, a second portion, a first electrode, and a second electrode. The first portion is configured to contact a first surface of a first substrate and an edge surface of the first substrate. The edge surface extends between the first surface and a second surface of the first substrate opposite to the first surface. The second portion is configured to contact the second surface of the first substrate. The first electrode extends through the first portion. The second electrode is within the second portion and is configured to couple the first electrode to an electrode on the second surface of the first substrate.



CONNECTORS FOR SUBSTRATES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of priority of U.S. Provisional Application Serial No. 62/587,121 filed on November 16, 2017 the contents of which are relied upon and incorporated herein by reference in their entirety as if fully set forth below.

BACKGROUND

Field

[0002] The present disclosure relates generally to apparatuses and methods for electrically contacting substrates using connectors. More particularly, the present disclosure relates to edge connectors to electrically contact top electrodes on adjacent substrates, for example in displays fabricated from multiple sub-displays.

Technical Background

[0003] Fine pitch light emitting diode (LED) and microLED are display technologies that use discrete LED components arranged in an array on a substrate for display or signage applications. A larger microLED display may be made from a plurality of smaller microLED sub-displays. The smaller microLED sub-displays may be fabricated and then arranged adjacent to each other in a tiled configuration to provide the larger display. Power and electrical signals are routed to each microLED sub-display to control each microLED such that the desired images and/or video is generated by the display.

[0004] Tiled sub-displays forming a larger display may suffer from visible seams between the sub-displays. Accordingly, apparatuses and methods for electrically contacting sub-displays with less visible seams are disclosed herein.

SUMMARY

[0005] Some embodiments of the present disclosure relate to a connector comprising: a first portion configured to contact a first surface of a first substrate and an edge surface of the first substrate, the edge surface extending between the first surface and a second surface of the first substrate opposite to the first surface; a first electrode extending through the first portion; and a second portion configured to contact the second surface of the first substrate

and including a second electrode configured to couple the first electrode to an electrode on the second surface of the first substrate.

[0006] In some embodiments, the second electrode can be orthogonal to the first electrode.

[0007] The connector may further comprise an anchor coupled to the first portion and configured to couple the connector to a support frame.

[0008] In some embodiments, the second portion may be removably coupled to the first portion.

[0009] In some embodiments, the connector may further comprise a fastener to removably couple the second portion to the first portion.

[0010] In some embodiments, the first electrode can extend through the second portion and the second electrode.

[0011] In some embodiments of the connector, the first portion comprises a tab, and the second portion comprises an opening to receive the tab and couple the first electrode to the second electrode.

[0012] The connector may further comprise a spring contact coupled to the second electrode.

[0013] In some embodiments, the first portion and the second portion can each comprise a compliant material.

[0014] In certain embodiments, the first portion may be configured to contact a first surface of a second substrate and an edge surface of the second substrate, the edge surface of the second substrate extending between the first surface of the second substrate and a second surface of the second substrate opposite to the first surface of the second substrate, the second portion configured to contact the second surface of the second substrate, and the second electrode configured to couple the first electrode to an electrode on the second surface of the second substrate.

[0015] In certain embodiments, the connector may further comprise a third electrode extending through the first portion, the first portion configured to contact a first surface of a second substrate and an edge surface of the second substrate, the edge surface of the second substrate extending between the first surface of the second substrate and a second surface of the second substrate opposite the first surface of the second substrate, the second portion configured to contact the second surface of the second substrate; and a fourth electrode configured to couple the third electrode to an electrode on the second surface of the second substrate.

[0016] In other embodiments, a display is disclosed, the display comprising: a first substrate comprising a first surface, a second surface opposite to the first surface of the first substrate, and an edge surface extending between the first surface and the second surface of the first substrate, the first substrate further comprising a first electrode on the second surface of the first substrate; a second substrate comprising a first surface, a second surface opposite to the first surface of the second substrate, and an edge surface extending between the first surface and the second surface of the second substrate, the second substrate comprising a second electrode on the second surface of the second substrate; and a connector contacting the first, second, and edge surfaces of the first substrate and the first, second, and edge surfaces of the second substrate, the connector comprising a third electrode coupled to the first electrode and a fourth electrode coupled to the second electrode.

[0017] In some embodiments of the display, the first substrate may comprise a plurality of first electrodes on the second surface of the first substrate, the second substrate comprising a plurality of second electrodes on the second surface of the second substrate, and the connector comprising a plurality of third electrodes and a plurality of fourth electrodes, each of said third electrodes coupled to a corresponding first electrode and each of said fourth electrodes coupled to a corresponding second electrode.

[0018] In certain embodiments, the plurality of third electrodes and the plurality of fourth electrodes can be arranged in an alternating pattern.

[0019]

[0020] The display may further comprise a support frame, wherein the connector is coupled to the support frame.

[0021] In various embodiments, the first substrate can comprise an array of first light emitting devices comprising a first pitch between the first light emitting devices, wherein the second substrate comprises an array of second light emitting devices comprising a second pitch between the second light emitting devices, and a width of the second portion of the connector is less than the first pitch and the second pitch.

[0022] In other embodiments, a method for fabricating a display is disclosed, the method comprising: arranging a first substrate and a connector such that a first surface of the first substrate and an edge surface of the first substrate contact a first portion of the connector, the edge surface extending between the first surface and a second surface of the first substrate opposite the first surface and the connector comprising a first electrode extending through the first portion; and arranging a second portion of the connector and the first substrate such that

the second portion contacts the second surface of the first substrate, the second portion comprising a second electrode that contacts the first electrode and an electrode on the second surface of the first substrate.

[0023] The method may further comprise fastening the second portion of the connector to the first portion of the connector.

[0024] In various embodiments, the method may further comprise: arranging a second substrate and the connector such that a first surface of the second substrate and an edge surface of the second substrate contact the first portion of the connector, the edge portion of the second substrate extending between the first surface of the second substrate and a second surface of the second substrate opposite to the first surface of the second substrate and the connector further comprising a third electrode extending through the first portion, wherein arranging the second portion of the connector comprises arranging the second portion of the connector and the second substrate such that the second portion contacts the second surface of the second substrate, the second portion further comprising a fourth electrode that contacts the third electrode and an electrode on the second surface of the second substrate.

[0025] In some embodiments, the method may further comprise: arranging a second substrate and a further connector such that a first surface of the second substrate and an edge surface of the second substrate contact a first portion of the further connector, the edge surface of the second substrate extending between the first surface of the second substrate and a second surface of the second substrate opposite to the first surface of the second substrate and the further connector comprising a third electrode extending through the first portion of the further connector; arranging a second portion of the further connector over the second substrate such that the second portion of the further connector contacts the second surface of the second substrate, the second portion of the further connector comprising a fourth electrode that contacts the third electrode and an electrode on the second surface of the second substrate; and coupling the connector and the further connector to a support frame.

[0026] Additional features and advantages will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the embodiments as described herein, including the detailed description which follows, the claims, as well as the appended drawings.

[0027] It is to be understood that both the foregoing general description and the following detailed description describe various embodiments and are intended to provide an overview or framework for understanding the nature and character of the claimed subject matter. The

accompanying drawings are included to provide a further understanding of the various embodiments, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments described herein, and together with the description serve to explain the principles and operations of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] FIGS. 1A-1B schematically depict one example of a connector including alternating electrodes coupled to two adjacent substrates;

[0029] FIGS. 2A-2B schematically depict one example of a connector including electrodes coupled to two adjacent substrates;

[0030] FIGS. 3A-3B schematically depict another example of a connector including barbed electrodes;

[0031] FIG. 4 schematically depicts another example of a connector including interlocking portions;

[0032] FIG. 5 schematically depicts another example of a connector including spring contacts;

[0033] FIG. 6 schematically depicts one example of a connector for a single substrate;

[0034] FIG. 7 schematically depicts one example of a connector coupled to a support frame;

[0035] FIG. 8 schematically depicts another example of a connector coupled to a support frame;

[0036] FIG. 9 schematically depicts one example of a display;

[0037] FIGS. 10A-10B schematically depict example interfaces between connectors at corners of a substrate; and

[0038] FIG. 11 depicts one example of a method for fabricating a display.

DETAILED DESCRIPTION

[0039] Reference will now be made in detail to embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings. Whenever possible, the same reference numerals will be used throughout the drawings to refer to the same or like parts. However, this disclosure may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein.

[0040] Ranges can be expressed herein as from “about” one particular value, and/or to “about” another particular value. When such a range is expressed, another embodiment includes from the one particular value and/or to the other particular value. Similarly, when values are expressed as approximations, by use of the antecedent “about,” it will be understood that the particular value forms another embodiment. It will be further understood that the endpoints of each of the ranges are significant both in relation to the other endpoint, and independently of the other endpoint.

[0041] Directional terms as used herein - for example up, down, right, left, front, back, top, bottom, vertical, horizontal - are made only with reference to the figures as drawn and are not intended to imply absolute orientation.

[0042] Unless otherwise expressly stated, it is in no way intended that any method set forth herein be construed as requiring that its steps be performed in a specific order, nor that with any apparatus, specific orientations be required. Accordingly, where a method claim does not actually recite an order to be followed by its steps, or that any apparatus claim does not actually recite an order or orientation to individual components, or it is not otherwise specifically stated in the claims or description that the steps are to be limited to a specific order, or that a specific order or orientation to components of an apparatus is not recited, it is in no way intended that an order or orientation be inferred, in any respect. This holds for any possible non-express basis for interpretation, including: matters of logic with respect to arrangement of steps, operational flow, order of components, or orientation of components; plain meaning derived from grammatical organization or punctuation, and; the number or type of embodiments described in the specification.

[0043] As used herein, the singular forms “a,” “an,” and “the” include plural references unless the context clearly dictates otherwise. Thus, for example, reference to “a” component includes aspects having two or more such components, unless the context clearly indicates otherwise.

[0044] Referring now to FIGS. 1A-1B, an exemplary connector 100 including alternating electrodes coupled to two adjacent substrates 120a and 120b is schematically depicted. FIG. 1A illustrates a sectional view and FIG. 1B illustrates a top view of connector 100 and substrates 120a and 120b. Connector 100 couples substrates 120a and 120b to each other. In one example, substrates 120a and 120b are sub-displays and connector 100 couples the two sub-displays together to provide a larger display.

[0045] First substrate 120a includes a first surface 126a, a second surface 128a opposite to the first surface 126a, and an edge surface 130a extending between the first surface 126a and the second surface 128a. First substrate 120a also includes a plurality of electrodes 122a and a plurality of devices 124a on the second surface 128a of first substrate 120a. Each electrode 122a is electrically coupled to a device 124a. Likewise, second substrate 120b includes a first surface 126b, a second surface 128b opposite to the first surface 126b, and an edge surface 130b extending between the first surface 126b and the second surface 128b. Second substrate 120b also includes a plurality of electrodes 122b and a plurality of devices 124b on the second surface 128b of second substrate 120b. Each electrode 122b is electrically coupled to a device 124b. Electrodes 122a and 122b may be thin film micro electrodes made of copper or another suitable electrically conductive metal (e.g., silver, gold, aluminum, etc). In one example, electrodes 122a and 122b provide signal and/or power connections to devices 124a and 124b, respectively.

[0046] Devices 124a and 124b may be light emitting devices, such as light emitting diodes (LEDs) or microLEDs. As depicted in FIG. 1B, electrodes 122a of first substrate 120a may be offset with respect to electrodes 122b of second substrate 120b. While first substrate 120a and second substrate 120b depicted in FIGS. 1A-1B each include one column of devices 124a and 124b respectively, in other examples first substrate 120a and second substrate 120b may include any suitable number of devices 124a and 124b, respectively, arranged in any suitable number of rows and columns.

[0047] Connector 100 includes a first portion 102 and a second portion 104. First portion 102 and second portion 104 may include a compliant material. In this example, first portion 102 and second portion 104 are separate components. Second portion 104 is removably coupled to first portion 102 via fasteners 110a and 110b. First portion 102 includes a base region 114 including upper surfaces that contact the first surface 126a of first substrate 120a and the first surface 126b of second substrate 120b. First portion 102 also includes a central region 116 extending from the upper surfaces of the base region 114. The central region 116 includes sidewalls that contact the edge surface 130a of first substrate 120a and the edge surface 130b of second substrate 120b.

[0048] Second portion 104 contacts the second surface 128a of first substrate 120a and the second surface 128b of second substrate 120b. Second portion 104 also extends over and contacts the top of the central region 116 of first portion 102. In one example, first substrate 120a includes an array of first light emitting devices 124a having a first pitch between the

first light emitting devices, and second substrate 120b includes an array of second light emitting devices 124b having a second pitch between the second light emitting devices. In this example, a width indicated by 105 of second portion 104 of connector 100 is less than the first pitch and the second pitch. The width 105 may be between about 15 μ m and 300 μ m in some examples. In other examples, the width 105 may be up to several millimeters depending upon the application.

[0049] A plurality of first electrodes 106a and 106b extend through the first portion 102 including the base region 114 and the central region 116. A plurality of second electrodes 108a and 108b are within second portion 104. In one example, each second electrode 108a and 108b is orthogonal to each first electrode 106a and 106b. Each first electrode 106a electrically contacts a second electrode 108a, and each first electrode 106b electrically contacts a second electrode 108b at an interface 112 between first portion 102 and second portion 104. Each second electrode 108a electrically couples a first electrode 106a to an electrode 122a of first substrate 120a. Each second electrode 108b electrically couples a first electrode 106b to an electrode 122b of second substrate 120b. Each first electrode 106a and 106b and each second electrode 108a and 108b may be made of copper or another suitable electrically conductive metal (e.g., silver, gold, aluminum, etc.).

[0050] The device of FIGS. 1A-1B can be assembled by arranging first substrate 120a and second substrate 120b onto first portion 102 of connector 100. Second portion 104 of connector 100 can then be arranged over first substrate 120a, second substrate 120b, and first portion 102 of connector 100. Second portion 104 may then be secured to the first portion 102 with fasteners (e.g., screws, bolts, rods, pins, etc.) 110a and 110b. Fasteners 110a are arranged between second electrodes 108a, and fasteners 110b are arranged between second electrodes 108b.

[0051] Connector 100 and the other connectors described herein below may be fabricated via micro-machining, injection molding, 3D-printing, and/or by other suitable methods. The connectors may be made from a variety of materials to meet electrical, optical, and/or mechanical specifications for a particular application. For example, in a microLED display application, connector 100 may be made from a material that is dark (i.e., light absorbing) and compliant (e.g., silicone) to minimize or effectively eliminate the visibility of the seam between sub-displays. The connectors enable microLED sub-displays to be fabricated in a more traditional manner with top electrodes. As such, through-substrate electrical

connections are not needed and thin film electrodes do not need to be coated around an edge of the substrates.

[0052] FIGS. 2A-2B schematically depict an exemplary connector 200 including electrodes coupled to two adjacent substrates 120a and 120b. FIG. 2A illustrates a sectional view and FIG. 2B illustrates a top view of connector 200 and substrates 120a and 120b. Connector 200 couples substrates 120a and 120b to each other. In one example, substrates 120a and 120b are sub-displays and connector 200 couples the two sub-displays together to provide a larger display. First substrate 120a and second substrate 120b were previously described and illustrated with reference to Figure 1A-1B. In this example, as depicted in FIG. 2B, electrodes 122a of first substrate 120a are aligned with electrodes 122b of second substrate 120b.

[0053] Connector 200 includes a first portion 202 and a second portion 204. First portion 202 and second portion 204 may, for example, include a compliant material. In this example, first portion 202 and second portion 204 are separate components. Second portion 204 is removably coupled to first portion 202 via fasteners 210. First portion 202 includes a base region 214 including upper surfaces that contact the first surface 126a of first substrate 120a and the first surface 126b of second substrate 120b. First portion 202 also includes a central region 216 extending from the upper surfaces of the base region 214. The central region 216 includes sidewalls that contact the edge surface 130a of first substrate 120a and the edge surface 130b of second substrate 120b. Second portion 204 contacts the second surface 128a of first substrate 120a and the second surface 128b of second substrate 120b. Second portion 204 also extends over and contacts the top of the central region 216 of first portion 202.

[0054] A plurality of first electrodes 206 extend through the first portion 202 including the base region 214 and the central region 216. A plurality of second electrodes 208 are within second portion 204. In one example, each second electrode 208 is orthogonal to each first electrode 206. Each first electrode 206 electrically contacts a second electrode 208 at an interface 212 between first portion 202 and second portion 204. Each second electrode 208 electrically couples a first electrode 206 to an electrode 122a of first substrate 120a and to an electrode 122b of second substrate 120b. Each first electrode 206 and each second electrode 208 may be made of copper or another suitable electrically conductive metal (e.g., silver, gold, aluminum, etc).

[0055] The device of FIGS. 2A-2B can be assembled by arranging first substrate 120a and second substrate 120b onto first portion 202 of connector 200. Second portion 204 of

connector 200 can then be arranged over first substrate 120a, second substrate 120b, and first portion 202 of connector 200. Second portion 204 may then be secured to the first portion 202 with fasteners (e.g., screws, bolts, rods, pins, etc.) 210. Fasteners 210 are arranged between second electrodes 210.

[0056] FIGS. 3A-3B schematically depict another example of a connector 300 including barbed electrodes. FIG. 3A illustrates a sectional view of connector 300 and FIG. 3B illustrates a top view of a second portion 304 of connector 300. Connector 300 is configured to couple substrates (e.g., 120a and 120b) to each other. In one example, the substrates are sub-displays and connector 300 is configured to couple the two sub-displays together to provide a larger display.

[0057] Connector 300 includes a first portion 302 and second portion 304. First portion 302 and second portion 304 may, for example, include a compliant material. In this example, first portion 302 and second portion 304 are separate components. Second portion 304 is coupled to first portion 302 via barbed portions 307a of first electrodes 306a and barbed portions 307b of second electrodes 306b. First portion 302 includes a base region 314 including upper surfaces that are configured to contact the first surface of a first substrate and the first surface of a second substrate. First portion 302 also includes a central region 316 extending from the upper surfaces of the base region 314. The central region 316 includes sidewalls that are configured to contact an edge surface of the first substrate and an edge surface of the second substrate. Second portion 304 is configured to contact the second surface of the first substrate and the second surface of the second substrate. Second portion 304 also extends over and contacts the top of the central region 316 of first portion 302.

[0058] A plurality of first electrodes 306a and 306b extend through the first portion 102 including the base region 314 and the central region 316 and through second portion 304. A plurality of second electrodes 308a and 308b are within second portion 304. In one example, each second electrode 308a and 308b is orthogonal to each first electrode 306a and 306b. Each second electrode 308a includes a through-hole through which a first electrode 306a extends to electrically couple each first electrode 306a to a second electrode 308a. Each second electrode 308b also includes a through-hole through which a first electrode 306b extends to electrically couple each first electrode 306b to a second electrode 308b. Each second electrode 308a is configured to electrically couple a first electrode 306a to an electrode on the second surface of the first substrate. Each second electrode 308b is configured to electrically couple a first electrode 306b to an electrode on the second surface

of the second substrate. Each first electrode 306a and 306b and each second electrode 308a and 308b may be made of copper or another suitable electrically conductive metal (e.g., silver, gold, aluminum, etc).

[0059] A device using connector 300 of FIGS. 3A-3B is assembled by arranging a first substrate and a second substrate onto first portion 302 of connector 300. Second portion 304 of connector 300 is arranged over the first substrate, the second substrate, and first portion 302 such that each first electrode 306a and 306b extends through a second electrode 308a and 308b, respectively, and through second portion 304. Accordingly, second portion 304 is secured to first portion 302 by barbed portions 307a and 307b of first electrodes 306a and 306b, respectively.

[0060] FIG. 4 schematically depicts another example of a connector 400 including interlocking portions. Connector 400 couples substrates 120a and 120b to each other. In one example, substrates 120a and 120b are sub-displays and connector 400 couples the two sub-displays together to provide a larger display. First substrate 120a and second substrate 120b were previously described and illustrated with reference to Figure 1A-1B.

[0061] Connector 400 includes a first portion 402 and a second portion 404. In this example, second portion 404 is shown separated from first portion 402 prior to coupling second portion 404 to first portion 402. First portion 402 and second portion 404 may include a compliant material or another suitable material. First portion 402 includes a base region 414 including upper surfaces that contact the first surface 126a of first substrate 120a and the first surface 126b of second substrate 120b. First portion 402 also includes a central region 416 extending from the upper surfaces of the base region 414. The central region 416 includes sidewalls that contact the edge surface 130a of first substrate 120a and the edge surface 130b of second substrate 120b.

[0062] Second portion 404 is removably coupled to first portion 402 via an interlocking feature 410 of first portion 402 and a corresponding interlocking feature 411 of second portion 404. In this example, interlocking feature 410 is in the form of a tab, and interlocking feature 411 is in the form of an opening to engage tab 410 of first portion 402. With second portion 404 coupled to first portion 402, second portion 404 contacts the second surface 128a of first substrate 120a and the second surface 128b of second substrate 120b. Second portion 404 also extends over and contacts the top of the central region 416 of first portion 402.

[0063] A plurality of first electrodes 406 extend through the first portion 402 including the base region 414 and the central region 416. A plurality of second electrodes 408 are within

second portion 404. In one example, each second electrode 408 is orthogonal to each first electrode 406 and has an inverted L shape. Each first electrode 406 electrically contacts a second electrode 408 at an interface 412 between first portion 402 and second portion 404 when second portion 404 is coupled to first portion 402. Each second electrode 408 electrically couples a first electrode 406 to an electrode 122a of first substrate 120a. Connector 400 may also include another plurality of first electrodes and another plurality of second electrodes to electrically contact electrodes 122b of second substrate 120b in a similar manner as previously described and illustrated with reference to FIGS. 1A-1B. Each first electrode 406 and each second electrode 408 may be made of copper or another suitable electrically conductive metal (e.g., silver, gold, aluminum, etc).

[0064] The device of FIG. 4 can be assembled by arranging first substrate 120a and second substrate 120b onto first portion 402 of connector 400. Second portion 404 of connector 400 can then be arranged over first substrate 120a, second substrate 120b, and first portion 402 of connector 400 such that opening 411 engages tab 410 to secure second portion 404 to first portion 402.

[0065] FIG. 5 schematically depicts another example of a connector 500 including spring contacts 509. Connector 500 couples a first substrate 120a and a second substrate (not shown) to each other. In one example, the first substrate 120a and the second substrate are sub-displays and connector 500 couples the two sub-displays together to provide a larger display. First substrate 120a was previously described and illustrated with reference to Figure 1A-1B.

[0066] Connector 500 includes a first portion 502 and a second portion 504. First portion 502 and second portion 504 may include, for example, a compliant material. In this example, first portion 502 and second portion 504 provide a single integral component. First portion 502 includes a base region 514 including upper surfaces that contact the first surface 126a of first substrate 120a and the first surface of a second substrate. First portion 502 also includes a central region 516 extending from the upper surfaces of the base region 514. The central region 516 includes sidewalls that contact the edge surface 130a of first substrate 120a and an edge surface of the second substrate. Spring contacts 509 of second portion 504 contact the second surface 128a of first substrate 120a and the second surface of the second substrate. Second portion 504 also extends over the central region 516 of first portion 502.

[0067] A plurality of first electrodes 506 extend through the first portion 502 including the base region 514 and the central region 516. A plurality of second electrodes 508 are within

second portion 504. A spring contact 509 is electrically coupled to each second electrode 508. In one example, each second electrode 508 is orthogonal to each first electrode 506. Each first electrode 506 is electrically coupled to a second electrode 508. Each second electrode 508 electrically couples a first electrode 506 to an electrode 122a of first substrate 120a via a spring contact 509. Connector 500 may also include another plurality of first electrodes and another plurality of second electrodes to electrically contact electrodes of a second substrate via spring contacts 509. Each first electrode 506, each second electrode 508, and each spring contact 509 may be made of copper or another suitable electrically conductive metal (e.g., silver, gold, aluminum, etc).

[0068] The device of FIG. 5 can be assembled by arranging first substrate 120a onto first portion 502 of connector 500 such that spring contacts 509 contact each electrode 122a of first substrate 120a. Connector 500 applies compression force onto first substrate 120a to hold first substrate 120a in place. A second substrate may be arranged on the other side of connector 500 opposite to first substrate 120a in a similar manner.

[0069] FIG. 6 schematically depicts exemplary connectors 600a and 600b, where each connector 600a and 600b is for a single substrate. Connectors 600a and 600b couple substrates 120a and 120b to each other via a support frame 620. In one example, substrates 120a and 120b are sub-displays and connectors 600a and 600b couple the two sub-displays together via support frame 620 to provide a larger display. First substrate 120a and second substrate 120b were previously described and illustrated with reference to Figure 1A-1B.

[0070] Each connector 600a and 600b includes a first portion 602 and a second portion 604. First portion 602 and second portion 604 may include, for example, a compliant material. In this example, first portion 602 and second portion 604 are separate components. Second portion 604 is removably coupled to first portion 602 via fasteners 610a and 610b. First portion 602 includes a base region 614 including an upper surface that contacts the first surface 126a of first substrate 120a or the first surface 126b of second substrate 120b. First portion 602 also includes a side region 616 extending from the upper surface of the base region 614. The side region 616 includes a sidewall that contacts the edge surface 130a of first substrate 120a or the edge surface 130b of second substrate 120b. Second portion 604 contacts the second surface 128a of first substrate 120a or the second surface 128b of second substrate 120b. Second portion 604 also extends over and contacts the top of the side region 616 of first portion 602.

[0071] A plurality of first electrodes 606 extend through the first portion 602 including the base region 614 and the side region 616. Each first electrode 606 includes a protruding portion 607 at the bottom of first portion 602 to electrically couple first portion 602 to support frame 620 by plugging the protruding portions 607 into the support frame. A plurality of second electrodes 608 are within second portion 604. In one example, each second electrode 608 is orthogonal to each first electrode 606. Each first electrode 606 electrically contacts a second electrode 608 at an interface 612 between first portion 602 and second portion 604. Each second electrode 608 electrically couples a first electrode 606 to an electrode 122a of first substrate 120a or to an electrode 122b of second substrate 120b. Each first electrode 606 and each second electrode 608 may be made of copper or another suitable electrically conductive metal (e.g., silver, gold, aluminum, etc.).

[0072] The device of FIG. 6 can be assembled by arranging first substrate 120a onto first portion 602 of first connector 600a and arranging second substrate 120b onto first portion 602 of second connector 600b. Second portion 604 of first connector 600a can be arranged over first substrate 120a and first portion 602 of first connector 600a, and second portion 604 of second connector 600b can be arranged over second substrate 120b and first portion 602 of second connector 600b. The second portion 604 of first connector 600a and second connector 600b can be secured to the corresponding first portion 602 with fasteners (e.g., screws, bolts, rods, pins, etc.) 610a and 610b. Fasteners 610a can be arranged between second electrodes 608 towards the center of second portion 604, and fasteners 610b can be arranged adjacent to second electrodes 608 towards the edge of second portion 604 and first portion 602. First connector 600a and second connector 600b can then be plugged into support frame 620.

[0073] FIG. 7 schematically depicts an exemplary connector 700 coupled to a support frame 720. Connector 700 includes a first portion 702 and a second portion 704. A first substrate 120a is coupled to connector 700. In other examples, a second substrate 120b can also be coupled to connector 700. In one example, connector 700 can include connector 100, 200, 300, 400, 500, or 600 previously described and illustrated with reference to FIGS. 1A-6.

[0074] An anchor 730 couples first portion 702 of connector 700 to support frame 720. In one example, anchor 730 may be removably coupled (e.g., via a fastener, via interlocking components, etc.) to a sidewall of first portion 702 or mechanically fixed (e.g., welded, soldered, glued, etc.) to a sidewall of first portion 702. Anchor 730 may also be removably coupled (e.g., via a fastener, via interlocking components, etc.) to support frame 720 or

mechanically fixed (e.g., welded, soldered, glued, etc.) to support frame 720. In another example, anchor 730 may be integral to second portion 702 such that second portion 702 and anchor 730 are a single component or anchor 730 may be integral to support frame 720 such that support frame 720 and anchor 730 are a single component.

[0075] FIG. 8 schematically depicts another example of a connector 800 coupled to a support frame 820. Connector 800 includes a first portion 802 and a second portion 804. A first substrate 120a is coupled to connector 800. In other examples, a second substrate 120b is also coupled to connector 800. In one example, connector 800 includes connector 100, 200, 300, 400, 500, or 600 previously described and illustrated with reference to FIGS. 1A-6.

[0076] An anchor 830 couples first portion 802 of connector 800 to support frame 820. In one example, anchor 830 may be removably coupled (e.g., via a fastener, via interlocking components, etc.) to the bottom of first portion 802 or mechanically fixed (e.g., welded, soldered, glued, etc.) to the bottom of first portion 802. Anchor 830 may also be removably coupled (e.g., via a fastener, via interlocking components, etc.) to support frame 820 or mechanically fixed (e.g., welded, soldered, glued, etc.) to support frame 820. In another example, anchor 830 may be integral to second portion 802 such that second portion 802 and anchor 830 are a single component.

[0077] FIG. 9 schematically depicts an exemplary display 900. Display 900 includes a first substrate 120a, a second substrate 120b, and connectors 902 and 904. One connector 902 couples first substrate 120a to second substrate 120b. The remaining connectors 902 and 904 may couple first substrate 120a and second substrate 120b to further substrates (not shown) to provide a display including any suitable number of rows and columns of sub-displays.

[0078] Each connector 902 may be a connector 100, 300, 400, or 500 as previously described and illustrated with reference to FIGS. 1A-1B, 3A-3B, 4, and 5, respectively. Each connector 902 includes alternating electrodes to electrically contact electrodes 122a and 122b of adjacent substrates 120a and 120b having separate addressing. Each connector 904 may be a connector 200 as previously described and illustrated with reference to FIGS. 2A-2B. Each connector 904 includes electrodes to electrically contact electrodes 123a and 123b to corresponding electrodes of adjacent substrates (not shown) having the same addressing. In this example, an anchor 906 between each connector 902 and 904 couples each connector and thus first substrate 120a and second substrate 120b to a support frame (not shown).

[0079] FIGS. 10A-10B schematically depict exemplary interfaces between connectors at corners of a substrate, such as substrates 120a and 120b of FIG. 9. As depicted in FIG. 10A, a connector 902a may be coupled to a first side of a substrate and a connector 904a may be coupled to a second side of the substrate orthogonal to the first side of the substrate. In this example, connectors 902a and 904a do not extend beyond the ends of the first side and the second side of the substrate. As depicted in FIG. 10B, a connector 902b may be coupled to a first side of a substrate and a connector 904b may be coupled to a second side of the substrate orthogonal to the first side of the substrate. In this example, connectors 902b and 904b extend beyond the ends of the first side and the second side of the substrate such that connector 902b abuts connector 904b along a mitered edge 910 of each connector.

[0080] FIG. 11 depicts an exemplary method 950 for fabricating a display. At 952, method 950 includes placing a first substrate on a connector such that a first surface of the first substrate and an edge surface of the first substrate contact a first portion of the connector, the edge surface extending between the first surface and a second surface of the first substrate opposite to the first surface and the connector comprising a first electrode extending through the first portion. At 954, method 950 includes placing a second portion of the connector over the first substrate such that the second portion contacts the second surface of the first substrate, the second portion comprising a second electrode that contacts the first electrode and an electrode on the second surface of the first substrate. In one example, method 950 includes fastening the second portion of the connector to the first portion of the connector.

[0081] In another example, method 950 may include placing a second substrate on the connector such that a first surface of the second substrate and an edge surface of the second substrate contact the first portion of the connector. The edge portion of the second substrate extends between the first surface of the second substrate and a second surface of the second substrate opposite to the first surface of the second substrate. The connector may further include a third electrode extending through the first portion. In this example, placing the second portion of the connector includes placing the second portion of the connector over the second substrate such that the second portion contacts the second surface of the second substrate. Also in this example, the second portion may further includes a fourth electrode that contacts the third electrode and an electrode on the second surface of the second substrate.

[0082] In another example, method 950 may include placing a second substrate on a further connector such that a first surface of the second substrate and an edge surface of the

second substrate contact a first portion of the further connector. The edge surface of the second substrate extends between the first surface of the second substrate and a second surface of the second substrate opposite to the first surface of the second substrate. The further connector includes a third electrode extending through the first portion of the further connector. In this example, method 950 may further include placing a second portion of the further connector over the second substrate such that the second portion of the further connector contacts the second surface of the second substrate. The second portion of the further connector can include a fourth electrode that contacts the third electrode and an electrode on the second surface of the second substrate. In this example, method 950 also includes coupling the connector and the further connector to a support frame.

[0083] It will be apparent to those skilled in the art that various modifications and variations can be made to embodiments of the present disclosure without departing from the spirit and scope of the disclosure. Thus, it is intended that the present disclosure cover such modifications and variations provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A display comprising:

a first substrate comprising a first surface, a second surface opposite to the first surface of the first substrate, and an edge surface extending between the first surface and the second surface of the first substrate, the first substrate further comprising a first electrode on the second surface of the first substrate;

a second substrate comprising a first surface, a second surface opposite to the first surface of the second substrate, and an edge surface extending between the first surface and the second surface of the second substrate, the second substrate comprising a second electrode on the second surface of the second substrate; and

a connector contacting the first, second, and edge surfaces of the first substrate and the first, second, and edge surfaces of the second substrate, the connector comprising a third electrode coupled to the first electrode and a fourth electrode coupled to the second electrode.

2. The display of claim 1, wherein the first substrate comprises a plurality of first electrodes on the second surface of the first substrate,

the second substrate comprises a plurality of second electrodes on the second surface of the second substrate, and

the connector comprises a plurality of third electrodes and a plurality of fourth electrodes, each of said third electrodes coupled to a corresponding first electrode and each of said fourth electrodes coupled to a corresponding second electrode.

3. The display of claim 2, wherein the plurality of third electrodes and the plurality of fourth electrodes are arranged in an alternating pattern.

4. The display of claim 1, further comprising a support frame, wherein the connector is coupled to the support frame.

5. The display of claim 1, wherein the first substrate comprises an array of first light emitting devices comprising a first pitch between the first light emitting devices,

the second substrate comprises an array of second light emitting devices comprising a second pitch between the second light emitting devices, and

a width of the second portion of the connector is less than the first pitch and the second pitch.

6. A method for fabricating a display, the method comprising:

arranging a first substrate and a connector such that a first surface of the first substrate and an edge surface of the first substrate contact a first portion of the connector, the edge surface extending between the first surface and a second surface of the first substrate opposite the first surface and the connector comprising a first electrode extending through the first portion; and

arranging a second portion of the connector and the first substrate such that the second portion contacts the second surface of the first substrate, the second portion comprising a second electrode that contacts the first electrode and an electrode on the second surface of the first substrate.

7. The method of claim 6, further comprising fastening the second portion of the connector to the first portion of the connector.

8. The method of claim 6, further comprising:

arranging a second substrate and the connector such that a first surface of the second substrate and an edge surface of the second substrate contact the first portion of the connector, the edge portion of the second substrate extending between the first surface of the second substrate and a second surface of the second substrate opposite to the first surface of the second substrate and the connector further comprising a third electrode extending through the first portion,

wherein arranging the second portion of the connector comprises arranging the second portion of the connector and the second substrate such that the second portion contacts the second surface of the second substrate, the second portion further comprising a fourth electrode that contacts the third electrode and an electrode on the second surface of the second substrate.

9. The method of claim 6, further comprising:

arranging a second substrate and a further connector such that a first surface of the second substrate and an edge surface of the second substrate contact a first portion of the

further connector, the edge surface of the second substrate extending between the first surface of the second substrate and a second surface of the second substrate opposite to the first surface of the second substrate and the further connector comprising a third electrode extending through the first portion of the further connector;

arranging a second portion of the further connector over the second substrate such that the second portion of the further connector contacts the second surface of the second substrate, the second portion of the further connector comprising a fourth electrode that contacts the third electrode and an electrode on the second surface of the second substrate; and

coupling the connector and the further connector to a support frame.

10. A connector comprising:

a first portion configured to contact a first surface of a first substrate and an edge surface of the first substrate, the edge surface extending between the first surface and a second surface of the first substrate opposite to the first surface;

a first electrode extending through the first portion;

a second portion configured to contact the second surface of the first substrate and including a second electrode configured to couple the first electrode to an electrode on the second surface of the first substrate.

11. The connector of claim 10, wherein the second electrode is orthogonal to the first electrode.

12. The connector of claim 10, further comprising an anchor coupled to the first portion and configured to couple the connector to a support frame.

13. The connector of claim 10, wherein the second portion is removably coupled to the first portion.

14. The connector of claim 13, further comprising a fastener to removably couple the second portion to the first portion.

15. The connector of claim 10, wherein the first electrode extends through the second portion and the second electrode.
16. The connector of claim 10, wherein the first portion comprises a tab, and the second portion comprises an opening to receive the tab and couple the first electrode to the second electrode.
17. The connector of claim 10, further comprising a spring contact coupled to the second electrode.
18. The connector of claim 10, wherein the first portion and the second portion each comprise a compliant material.
19. The connector of claim 10, wherein the first portion is configured to contact a first surface of a second substrate and an edge surface of the second substrate, the edge surface of the second substrate extending between the first surface of the second substrate and a second surface of the second substrate opposite to the first surface of the second substrate,
wherein the second portion is configured to contact the second surface of the second substrate, and
the second electrode is configured to couple the first electrode to an electrode on the second surface of the second substrate.
20. The connector of claim 10, further comprising:
a third electrode extending through the first portion, the first portion configured to contact a first surface of a second substrate and an edge surface of the second substrate, the edge surface of the second substrate extending between the first surface of the second substrate and a second surface of the second substrate opposite the first surface of the second substrate, the second portion configured to contact the second surface of the second substrate; and
a fourth electrode configured to couple the third electrode to an electrode on the second surface of the second substrate.

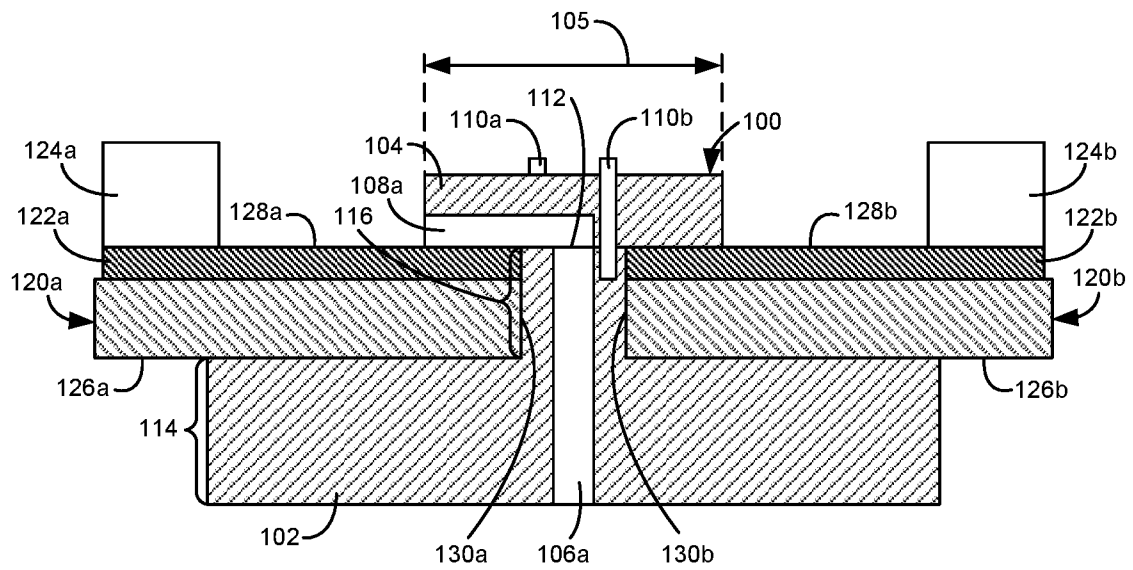


FIG. 1A

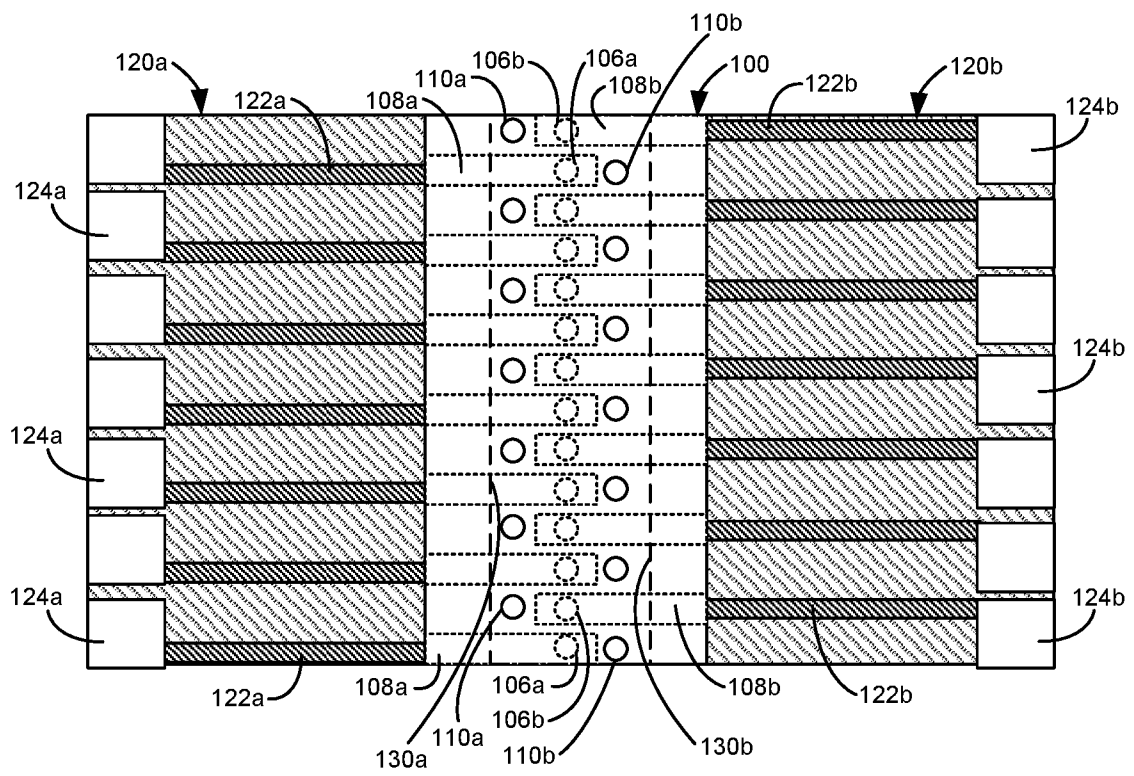


FIG. 1B

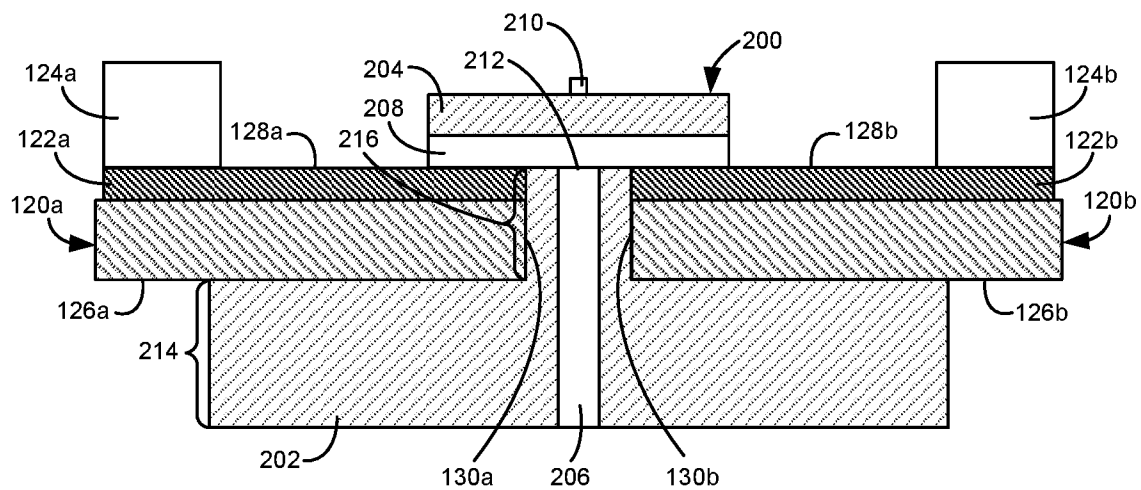


FIG. 2A

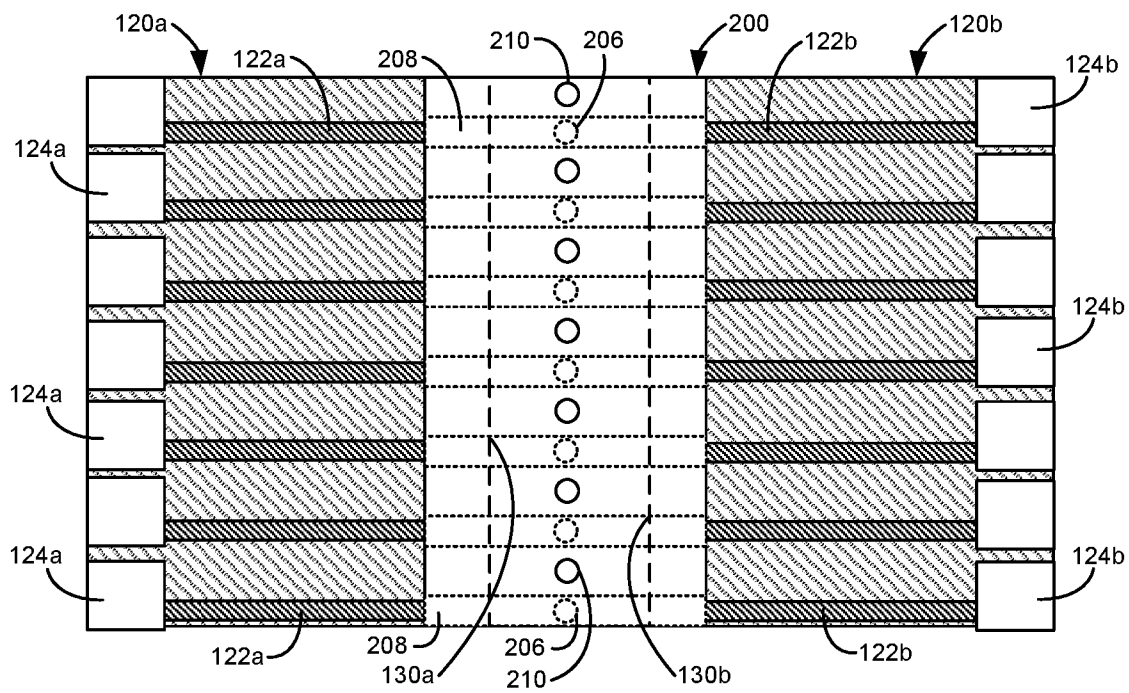


FIG. 2B

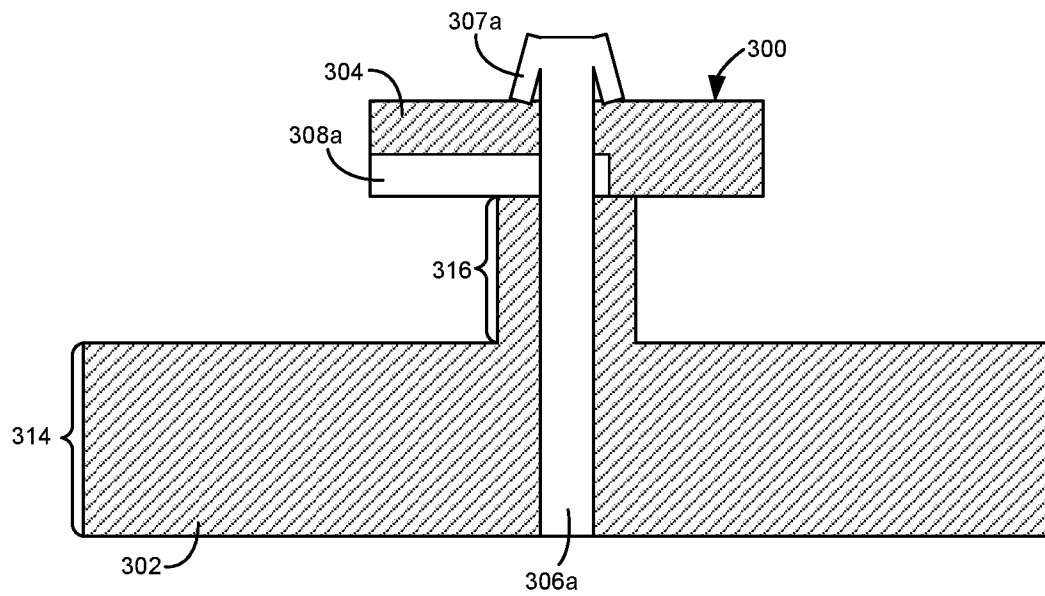


FIG. 3A

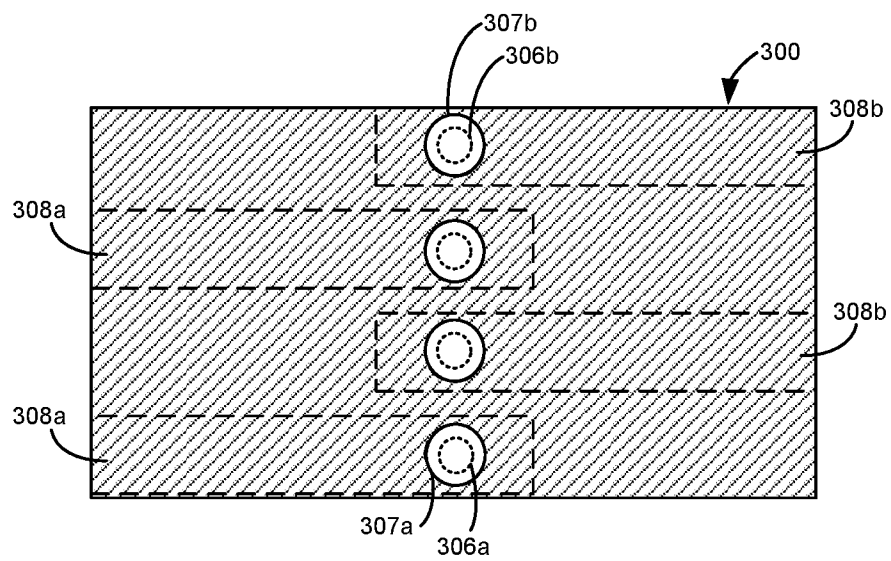


FIG. 3B

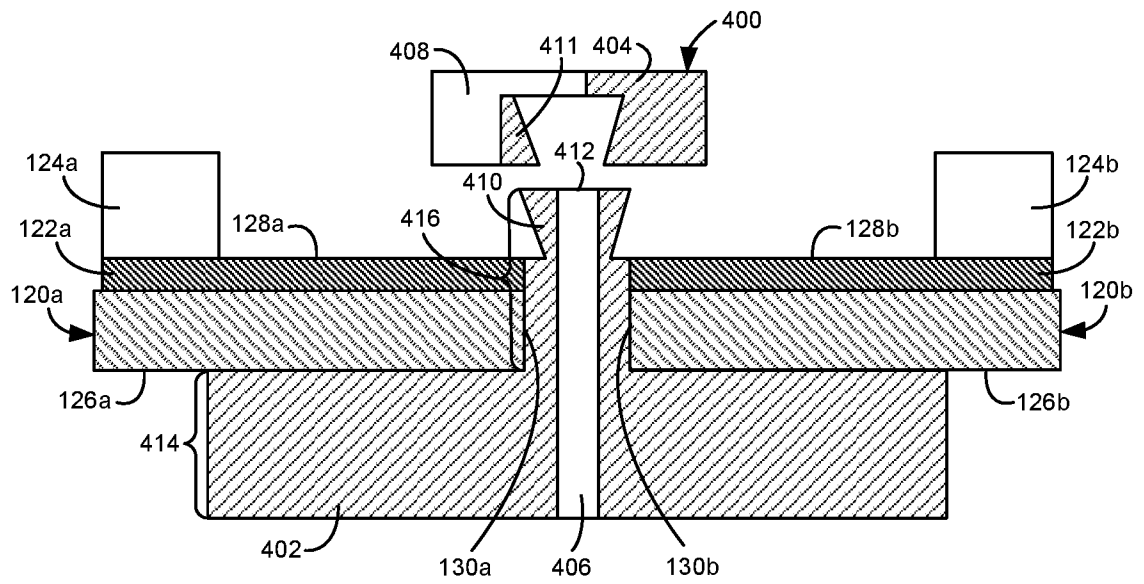


FIG. 4

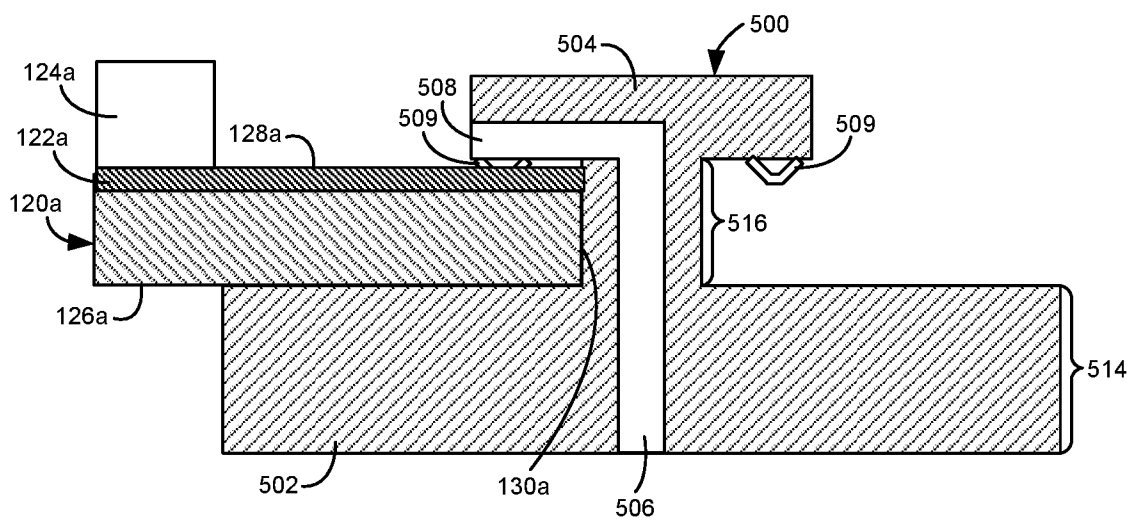


FIG. 5

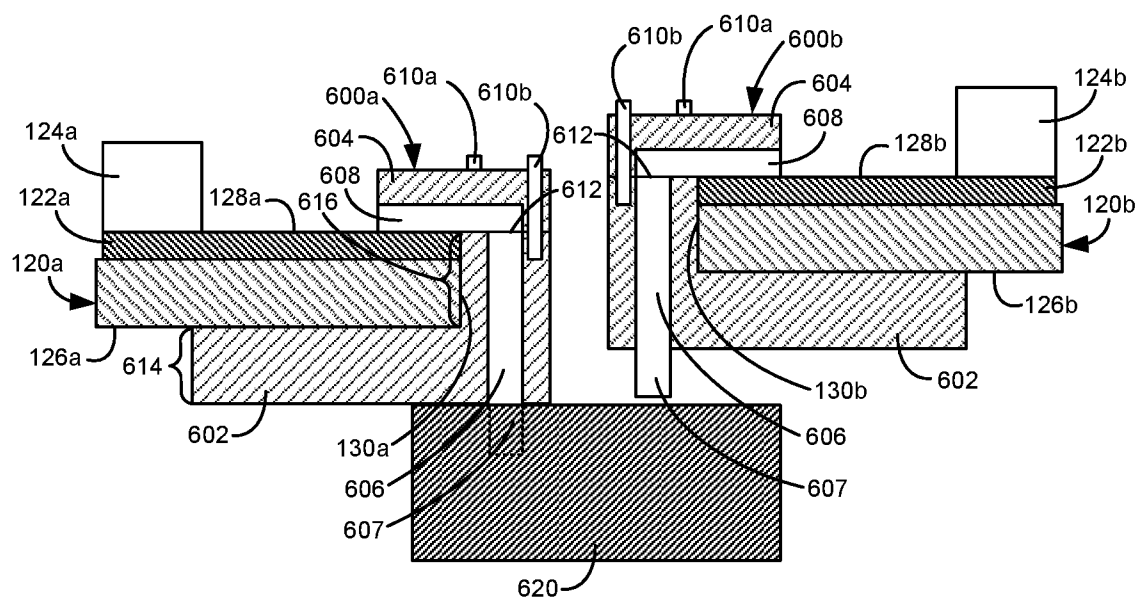


FIG. 6

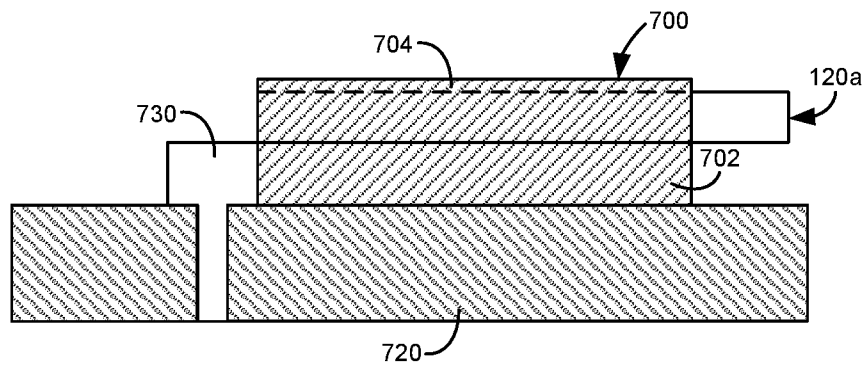


FIG. 7

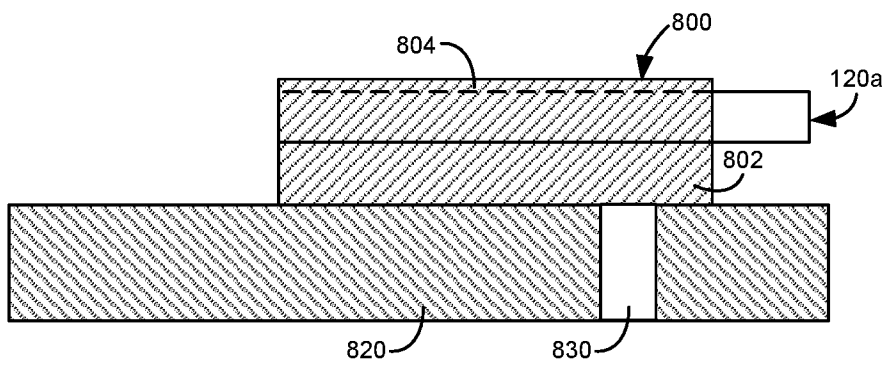


FIG. 8

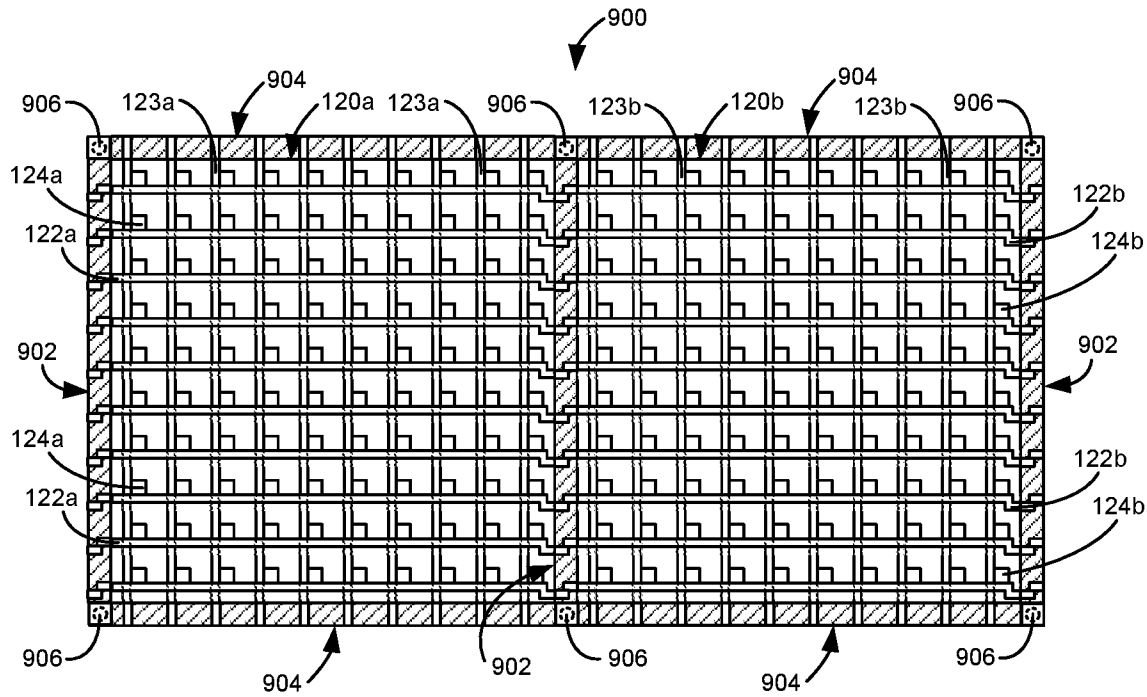


FIG. 9

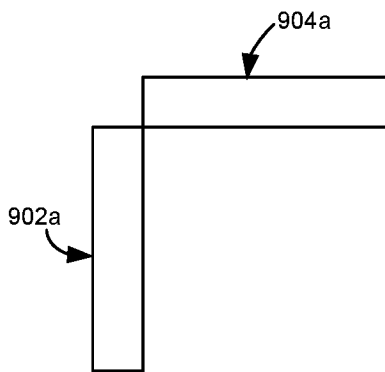


FIG. 10A

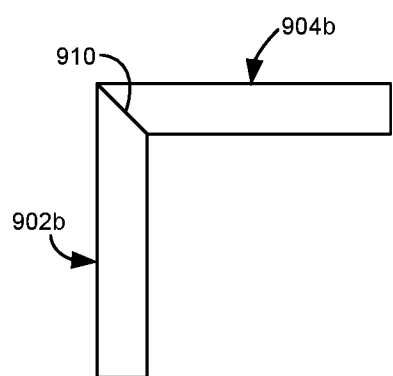


FIG. 10B

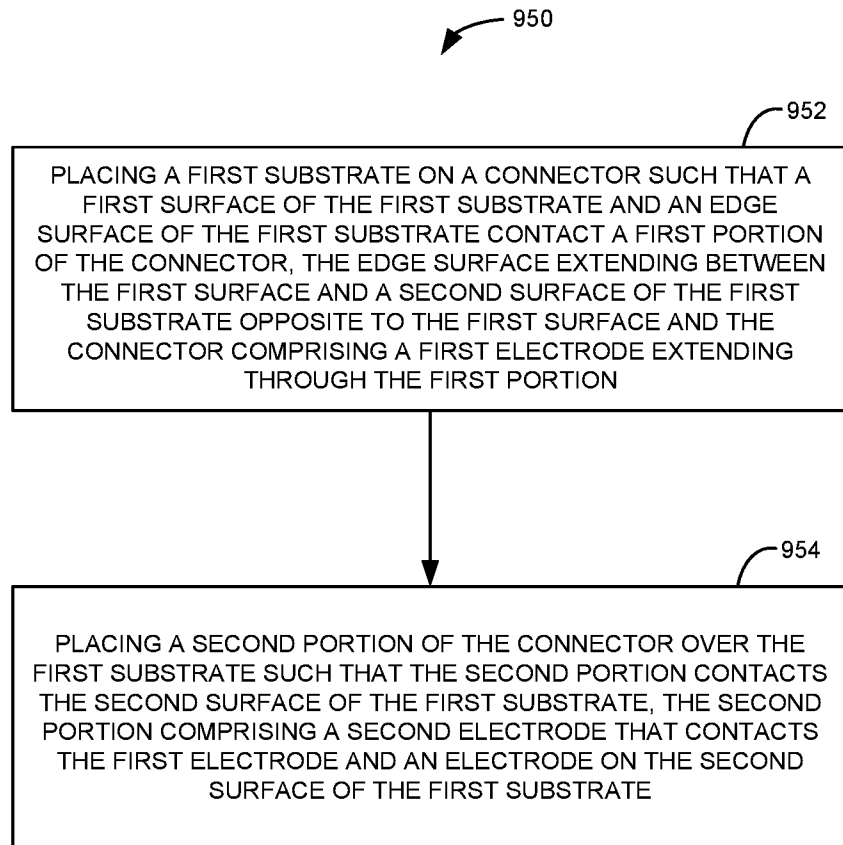


FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/059922**A. CLASSIFICATION OF SUBJECT MATTER****H01R 12/72(2011.01)i, H01R 12/73(2011.01)i, H01L 27/15(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01R 12/72; H01R 12/00; H01R 12/16; H05K 7/02; H01R 12/73; H01L 27/15

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: connector, first/second substrate, surface, first/second portion, electrode

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5355282 A (HITOSHI YOKEMURA et al.) 11 October 1994 See column 2, lines 51-56, column 3, lines 46-62 and figure 4.	1-4, 6-20
Y		5
Y	US 2008-0171451 A1 (CHANG-HO SHIN et al.) 17 July 2008 See paragraphs [0037]-[0041] and figures 2A-2B.	5
A	JP 2008-270052 A (MATSUSHITA ELECTRIC WORKS LTD.) 06 November 2008 See paragraphs [0014]-[0039] and figures 1-4.	1-20
A	JP 2012-221725 A (SMK CORP.) 12 November 2012 See paragraphs [0011]-[0013] and figures 1-3.	1-20
A	US 6382986 B1 (JONG-RYEUL KIM et al.) 07 May 2002 See column 4, line 24 - column 5, line 45 and figures 3-4.	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

22 February 2019 (22.02.2019)

Date of mailing of the international search report

22 February 2019 (22.02.2019)

Name and mailing address of the ISA/KR

International Application Division

Korean Intellectual Property Office

189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea

Facsimile No. +82-42-481-8578

Authorized officer

KANG, Sung Chul

Telephone No. +82-42-481-8405



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2018/059922

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5355282 A	11/10/1994	JP 05-062743 A	12/03/1993
US 2008-0171451 A1	17/07/2008	JP 05273622 B2	28/08/2013
		JP 2008-177164 A	31/07/2008
		JP 2010-212255 A	24/09/2010
		KR 10-0818510 B1	31/03/2008
		US 7462036 B2	09/12/2008
JP 2008-270052 A	06/11/2008	None	
JP 2012-221725 A	12/11/2012	CN 102738674 A	17/10/2012
		TW 201242172 A	16/10/2012
US 6382986 B1	07/05/2002	KR 10-0338774 B1	31/05/2002
		KR 10-2001-0014889 A	26/02/2001