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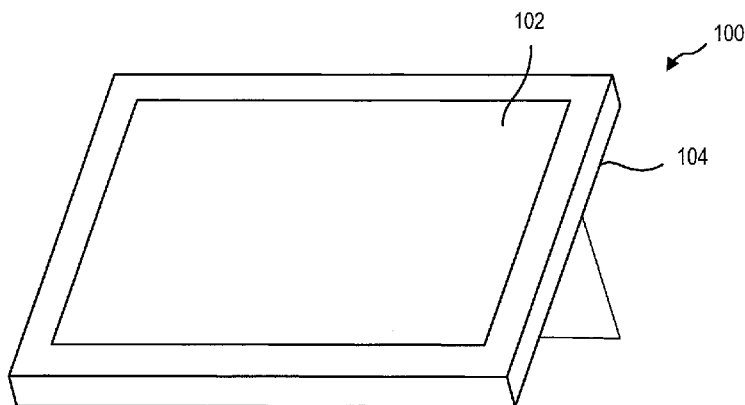


FIG. 1

(57) Abstract: An electronic device includes a touch film (208), an optically clear adhesive (206), and an electrical connector (212, 214). The touch film (208) has a metal trace (210, 222) positioned on a surface thereof, and the optically clear adhesive (206) contacts the metal trace (210, 222) and seals the metal trace (210, 222) with the touch film (208). The optically clear adhesive (206) and touch film (208) seal the metal trace (210, 222) against environmental corrosion. The electrical connector (212, 214) contacts and provides electrical communication with the metal trace (210, 222).



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SYSTEMS AND METHODS OF REDUCING CORROSION IN ELECTRICAL CONTACTS

CROSS-REFERENCE TO RELATED APPLICATIONS

5 [0001] N/A

BACKGROUND OF THE DISCLOSURE

[0002] Touch-sensing devices, such as touch-screen displays receive and detect inputs from a user through changes in electrical voltages, resistance, or current upon contact with or force applied by a user. Conventional touch-sensing devices in electronic devices include a sensing layer in communication with one or more components of the electronic device. The touch-sensing devices are incorporated into the electronic device at different stages during the manufacturing process depending on the electronic device. As the manufacturing of the associated electronic devices becomes more sophisticated, the components of the touch-sensing device are exposed to more and/or different environmental conditions that result in corrosion or other damage to the touch-sensing device.

SUMMARY

20 [0003] In some embodiments, an electronic device includes a touch film, an optically clear adhesive, and an electrical connector. The touch film has a metal trace positioned on a surface thereof, and the optically clear adhesive contacts the metal trace and seals the metal trace with the touch film. The optically clear adhesive and touch film seal the metal trace against environmental corrosion. The electrical connector contacts and provides electrical communication with the metal trace.

[0004] In some embodiments, a touch-sensing electronic device includes a touch film, a first optically clear adhesive, a second optically clear adhesive, a first electrical connector and a second electrical connector. The touch film has a first metal trace positioned on a first surface thereof and a second metal trace positioned on a second surface thereof. The first optically clear adhesive contacts the first metal trace and seals the first metal trace with the first surface of the touch film. The first optically clear

adhesive and first surface of the touch film seal the first metal trace against environmental corrosion. The second optically clear adhesive contacts the second metal trace and seals the second metal trace with the second surface of the touch film. The second optically clear adhesive and second surface of the touch film seal the second metal trace against environmental corrosion. The first electrical connector contacts and provides electrical communication with the first metal trace. The second electrical connector contacts and provides electrical communication with the second metal trace. The first optically clear adhesive at least partially surrounds the first electrical connector to seal the contact of the first electrical connector and the first metal trace. The second optically clear adhesive at least partially surrounds the second electrical connector to seal the contact of the second electrical connector and the second metal trace.

[0005] In some embodiments, a method of manufacturing an electronic device includes providing a metal trace on a surface of a touch film, positioning the metal trace in electrical communication with an electrical connector, and applying an optically clear adhesive over the metal trace and electrical connector such that the electrical connector is at least partially surrounded by the optically clear adhesive.

[0006] This summary is provided to introduce a selection of concepts that are further described below in the detailed description. This summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

[0007] Additional features and advantages of embodiments of the disclosure will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by the practice of such embodiments. The features and advantages of such embodiments may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims. These and other features will become more fully apparent from the following description and appended claims or may be learned by the practice of such embodiments as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] In order to describe the manner in which the above-recited and other features of the disclosure can be obtained, a more particular description will be rendered by

reference to specific embodiments thereof which are illustrated in the appended drawings. For better understanding, the like elements have been designated by like reference numbers throughout the various accompanying figures. While some of the drawings may be schematic or exaggerated representations of concepts, at least some of the drawings may be drawn to scale. Understanding that the drawings depict some example embodiments, the embodiments will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

[0009] FIG. 1 is a perspective view of an electronic device including a touch-sensing display, according to at least one embodiment of the present disclosure;

10 [0010] FIG. 2-1 is a plan view of conventional touch-sensing display;

[0011] FIG. 2-2 is a side cross-sectional view of the conventional touch-sensing display of FIG. 2-1;

[0012] FIG. 3 is a detail view of an electrical contact, according to some embodiments of the present disclosure;

15 [0013] FIG. 4-1 is a plan view of a receiving side of a touch-sensing display, according to some embodiments of the present disclosure;

[0014] FIG. 4-2 is a side cross-sectional view of the touch-sensing display of FIG. 4-1;

[0015] FIG. 5-1 is a plan view of a receiving side of another touch-sensing display, according to some embodiments of the present disclosure;

20 [0016] FIG. 5-2 is a side cross-sectional view of the touch-sensing display of FIG. 5-1;

[0017] FIG. 6-1 is a plan view of a transmission side of a touch-sensing display, according to some embodiments of the present disclosure;

25 [0018] FIG. 6-2 is a side cross-sectional view of the touch-sensing display of FIG. 6-1; and

[0019] FIG. 7 is a flowchart illustrating a method of reducing corrosion in a touch-sensing display, according to some embodiments of the present disclosure.

DETAILED DESCRIPTION

[0020] This disclosure generally relates to devices, systems, and methods for providing a touch-sensing surface in an electronic device. More specifically, the present disclosure relates to reducing corrosion in a touch-sensing device. In some embodiments, the touch-sensing device may be a touch-sensing display, where at least part of the touch-sensing device is optically transparent. For example, the touch-sensing display may be capable of receiving and transmitting inputs from a user in relation to objects, text, or other images displayed on the touch-sensing display. In other embodiments, the touch-sensing device may be independent of a display device and may receive inputs from a user without correlation to an overlaid (or underlaid) display. For example, the touch-sensing device may be a trackpad for user inputs to a computing device. The user inputs may be reflected on a display of the device without the touch-sensing device being a component of the display.

[0021] In some embodiments, the touch-sensing device may be part of a touch-sensing display of a tablet computer, a laptop computer, a desktop computer, other personal computing device, or a computing device integrated into another system, such as a control display for a medical device, a vehicle, building controls (e.g., a security system or a heat and ventilation system), or any other system with one or more control mechanisms. The touch-sensing display may have one or more metal traces embedded in the touch-sensing display that allows for the detection and measurement of user inputs. In some embodiments, the metal traces may be in electrical communication with an electrical connector to communicate with one or more components of a computing device. The metal traces and/or the electrical connector may be sealed after electrical communication is established to prevent environmental corrosion or degradation of the electrical contact.

[0022] FIG. 1 is a perspective view of an electronic device 100 with a touch-sensing display 102. The touch-sensing display 102 may include a liquid crystal display (LCD), a light-emitting diode (LED) display, an organic light-emitting diode (OLED) display, a plasma display, a laser diode array display, a microelectromechanical systems (MEMS) display, a waveguide, or other display mechanism for displaying visual information to a user. The touch-sensing display 102 may be a capacitive touch-sensing display that

includes a sensing layer that may detect the presence of a user's fingertip for input. For example, the touch-sensing display 102 may be a Surface Capacitive device, a Projected Capacitive Touch (PCT) device, a PCT Mutual Capacitance device, a PCT Self Capacitance device, or other capacitive touch-sensing devices. In other examples, the sensing layer may detect the presence of a user's fingertip through other electrical, magnetic, or mechanical means.

[0023] In some embodiments, the touch-sensing display 102 may be supported by a housing 104. The housing 104 may include and/or support other components of the electronic device 100. For example, the housing 104 may include and/or support a power supply, such as a converter for receiving electricity from a wired source or a battery for storing energy in the housing 104; one or more microprocessors; one or more hardware storage devices, such as a hard disk drive, a floppy disk, an optical disk drive and media, flash memory storage, or other mechanisms for data storage and reading; one or more communication devices to allow data communication with other electronic devices, such as a WIFI, BLUETOOTH, RFID, near field communications (NFC) device, ethernet, cellular, or other communication device; one or more peripheral connectors such as a Universal Series Bus (USB) connector, a display connector, an audio connector, or other peripheral connector; one or more audio input and/or output devices; one or more human interface devices, such as a trackpad, a mouse, a keyboard, or other human interface devices; one or more cameras; one or more lights; other components of the electronic device; or combinations thereof.

[0024] In some embodiments, the touch-sensing display 102 may include a stack of substantially flat components layered upon one another such that the broad surface of each component contacts the broad surface of each adjacent component. At least one of the layers may be a sensing layer that may detect and/or measure the touch of a user. FIG. 2-1 illustrates an example of a surface of a receiving side of a conventional touch-sensing display 202.

[0025] The conventional touch-sensing display 202 includes a sheet of an optically clear adhesive (OCA) 206 that adheres a touch film 208 to a cover glass (illustrated in FIG. 2-2). The touch film 208 has a sensing layer, such as a metal trace 210 that is between the OCA 206 and the touch film 208. The sensing layer detects the user's inputs

on the touch-sensing display 202 and communicates the inputs to a first electrical connector 212 on the receiving side of the touch film 208 and to a second electrical connector 214 on the opposite, transmission side of the touch film 208. To allow bonding of the first electrical connector 212 to the sensing layer, the OCA 206 has a notch 216 to expose a portion of the touch film 208 and metal trace 210.

[0026] FIG. 2-2 is a side cross-sectional view of the conventional touch-sensing display 202 of FIG. 2-1. The stack of components includes a touch film 208 with a first metal trace 210 on a receiving side. The first metal trace 210 is in electrical communication with the first electrical connector 212 positioned in the notch 216 between a cover member 220 and the touch film 208. A first conductive element 218 is positioned between the first electrical connector 212 and the first metal trace 210. At least a portion of the first metal trace 210 is not covered by the OCA 206 and is exposed to environmental gases and/or fluids that may react with the first metal trace 210. For example, a first metal trace 210 including silver reacts with sulfur during manufacturing to form silver sulfide, damaging the first metal trace 210 and the electrical communication from the first metal trace to the first electrical connector 212.

[0027] Similarly, the transmission side of the touch film 208 has a second OCA 224 positioned between a second metal trace 222 and a display screen 226, such as a liquid crystal module (LCM). The second metal trace 222 is in electrical communication with a second electrical connector 214 by a second conductive element 228. At least a portion of the second metal trace 222 is not covered by the second OCA 224 and is exposed to environmental gases and/or fluids that may react with the second metal trace 222.

[0028] FIG. 3 is a top detail view of an electrical contact 311 according to the present disclosure. The electrical contact 311 may include a sensing layer including a metal trace 310 positioned on a touch film 308. The metal trace 310 may include a plurality of wires or vias in electrical communication with an electrical connector 312 at the electrical contact 311. In some embodiments, the electrical contact 311 may be a portion of the metal trace 310 in which at least one of the wires or vias are flattened, widened, or otherwise configured to improve electrical communication between the metal trace 310 and the electrical connector 312.

[0029] In some embodiments, the metal trace 310 on the touch film 308 may undergo a passivation process by which a portion of the metal trace 310 may be passivated for manufacturing and handling. The passivation may provide some protection against corrosion, but may not completely prevent corrosion of the metal trace 310. In
5 embodiments with passivation of the metal trace 310, the passivation boundary 330 may not encompass all of the metal trace 310. For example, passivation may limit electrical communication with the electrical connector 312, and therefore, the electrical contact 311 of the metal trace 310 may be unpassivated. In some embodiments, passivated and/or unpassivated metal trace 310 may be sealed against environmental corrosion by an OCA
10 306 positioned over the metal trace 310 up to and/or including at least a portion of the electrical connector 312. For example, environmental corrosion may be any corrosion including a reactant introduced by from the environment around the touch-sensing display, as opposed to another component of the touch-sensing display. In at least one example, for a metal trace including copper, the formation of copper oxide from gaseous
15 oxygen in the environment around the touch-sensing device may be environmental corrosion. A metal trace that is covered by a layer of material that is impermeable to an environmental gas or fluid that may react to the metal trace may be considered “sealed” against that environmental gas or fluid.

[0030] In some embodiments, the metal trace 310 may be silver or a silver alloy. In
20 other embodiments, the metal trace 310 may be indium tin oxide (ITO). In further embodiments, the metal trace 310 may include or be copper or copper alloy. In yet other embodiments, the metal trace 310 may be any conductive material that is substantially optically transparent. For example, a substantially optically transparent material may be a material that transmits at least 90% of light in the visible spectrum (e.g., 390 nm to 700
25 nm). In other examples, a substantially optically transparent material may be a material that transmits at least 95% of light in the visible spectrum. In yet other examples, a substantially optically transparent material may be a material that transmits at least 98% of light in the visible spectrum.

[0031] The OCA 306 may be positioned over the passivated portion of the metal trace
30 310 up to the passivation boundary 330, as well as the unpassivated portion of the metal trace 310. In the illustrated embodiment, the OCA 306 may be positioned over at least a

portion of the electrical connector 312. In other embodiments, the OCA 306 may be positioned over the metal trace 310 up to and abutting an edge of, but not covering, the electrical connector 312. In yet other embodiments, the OCA 306 may cover all of the touch film 308 and the portion of the electrical connector 312 overlapping the touch film 308.

[0032] In some embodiments, the touch film 308 may be a substantially optically transparent material that is electrically insulating. The touch film 308 may be a flexible material. For example, the touch film 308 may be Polyethylene Terephthalate (PET). In other examples, the touch film 308 may be another polyester material. In yet other examples, the touch film 308 may include or be a polymer.

[0033] The electrical connector 312 may be a flexible printed circuit (FPC). A FPC may allow for a thin connector with a thickness less than that of the OCA 306. For example, the OCA 306 may have a thickness of about 75 micrometers, and the FPC electrical connector 312 may have a thickness less than the OCA 306, assisting the OCA 306 to fill in the spaces around the electrical connector 312 through deformation of the OCA 306 during application of the OCA 306.

[0034] FIG. 4-1 illustrates a receiving side of a touch-sensing display 402 according to the present disclosure. A touch-sensing display 402 may be assembled with the first electrical connector 412 and/or second electrical connector 414 positioned in electrical communication with a metal trace, and then a layer of a first OCA 406 and/or second OCA (not shown in FIG. 4-1) may be applied over the electrical contact of the metal trace to seal the metal trace and electrical contact of the metal trace between the metal trace and first electrical connector 412 and/or second electrical connector 414. In some embodiments, a layer of a first OCA 406 and/or second OCA (not shown in FIG. 4-1) may be applied over metal trace and the first electrical connector 412 and/or second electrical connector 414, respectively, to seal the metal trace and electrical contact of the metal trace between the metal trace and first electrical connector 412 and/or second electrical connector 414 before a cover member 420 or any other additional components are applied to the OCA 406.

[0035] FIG. 4-2 is a side cross-sectional view of the touch-sensing display 402 of FIG. 4-1 with additional electronic components. While the first electrical connector 412 and

second electrical connector 414 may be laterally offset, as shown in FIG. 4-1, for simplicity of discussion, the first electrical connector 412 and second electrical connector 414 and associated connection components are shown vertically stacked in FIG. 4-2 through the vertical cross-section. The stack of components includes a touch film 408
5 with a first metal trace 410 on a receiving side. In some embodiments, the first metal trace 410 may have a thickness in the direction normal to the touch film 408 of about 1 μm . In other embodiments, the first metal trace 410 may have a thickness in the direction normal to the touch film 408 of about 2 μm . In yet other embodiments, the first metal trace 410 may have a thickness in the direction normal to the touch film 408 of about 0.5
10 μm . Due to the relatively small thickness of the first metal trace 410, the first metal trace 410 may be particularly susceptible to corrosion damage.

[0036] The first metal trace 410 is in electrical communication with the first electrical connector 412. A first conductive element 418 is positioned between the first electrical connector 412 and the first metal trace 410. In some embodiments, the first conductive
15 element 418 may be a conductive adhesive. For example, the first conductive element 418 may be an anisotropic conductive adhesive. The first metal trace 410 may be fully covered by the first OCA 406 and sealed against environmental corrosion from environmental gases and/or fluids that may react with the first metal trace 410. For example, a first metal trace 410 including silver may be sealed such that it will not react
20 with sulfur during manufacturing to form silver sulfide.

[0037] In some embodiments, the first OCA 406 may cover and seal the first metal trace 410 up to and contacting an edge of the first electrical connector 412. In other embodiments, such as shown in FIG. 4-2, the first OCA 406 may overlap at least a portion of the first electrical connector 412. For example, the first OCA 406 may overlap
25 and at least partially surround the first electrical connector 412. The first OCA 406 may at least partially surround the first electrical connector 412 when the first OCA 406 contacts at least a top surface of the first electrical connector 412, as well as a front edge and the two side edges (as shown in plan view in FIG. 4-1). In other embodiments, the first OCA 406 may deform around the front edge and/or side edges of the first electrical
30 connector 412 such that a portion of the first OCA 406 may be positioned between the first electrical connector 412 and the first metal trace 410 behind the first conductive

element 418. In at least one embodiment, the first OCA 406 may contact the first electrical connector 412 on a top surface (further from the first metal trace 410), the front edge of the first electrical connector 412, the side edges of the first electrical connector 412, and a bottom surface (opposite the top surface and proximate the first metal trace 410).

[0038] Similarly, the transmission side of the touch film 408 has a second OCA 424 positioned between a second metal trace 422 and a display screen 426, such as a LCM. The second metal trace 422 is in electrical communication with a second electrical connector 414 by a second conductive element 428. In some embodiments, the second conductive element 428 may be a conductive adhesive. For example, the second conductive element 428 may be an anisotropic conductive adhesive. At least a portion of the second metal trace 422 is not covered by the second OCA 424 and is exposed to environmental gases and/or fluids that may react with the second metal trace 422.

[0039] In some embodiments, the second metal trace 422 may have a thickness in the direction normal to the touch film 408 of about 1 μm . In other embodiments, the second metal trace 422 may have a thickness in the direction normal to the touch film 408 of about 2 μm . In yet other embodiments, the second metal trace 422 may have a thickness in the direction normal to the touch film 408 of about 0.5 μm . Due to the relatively small thickness of the second metal trace 422, the second metal trace 422 may be particularly susceptible to corrosion damage.

[0040] In some embodiments, the second OCA 424 may cover and seal the second metal trace 422 up to the second electrical connector 414. In other embodiments, such as shown in FIG. 4-2, the second OCA 424 may overlap at least a portion of the first electrical connector 412. For example, second OCA 424 may overlap and at least partially surround the second electrical connector 414. The second OCA 424 may at least partially surround the second electrical connector 414 when the second OCA 424 contacts at least a top surface of the second electrical connector 414, as well as a front edge and the two side edges. In other embodiments, the second OCA 424 may deform around the front edge and/or side edges of the second electrical connector 414 such that a portion of the second OCA 424 may be positioned between the second electrical connector 414 and the second metal trace 422 behind the second conductive element 428.

In at least one embodiment, the second OCA 424 may contact the second electrical connector 414 on a top surface (further from the second metal trace 422), the front edge of the second electrical connector 414, the side edges of the second electrical connector 414, and a bottom surface (opposite the top surface and proximate the second metal trace 422).

[0041] In some embodiments, a conductive element (such as the first conductive element 418 and/or second conductive element 428) may be encapsulated to seal the conductive element against corrosion or damage. For example, an encapsulated conductive element may be contacted on all sides by components described herein without exposure to environment gases or fluids. In at least one example, a conductive element may be encapsulated by a metal trace 410, 422 and/or touch film 408, an OCA 406, 424, and an electrical connector 412, 414.

[0042] FIG. 5-1 illustrates another embodiment of a touch-sensing display 502, according to the present disclosure. In some embodiments, the touch-sensing display 502 may include only one layer of metal trace or other sensing layer. For example, the metal trace may include both rows and columns separated by a dielectric layer, allowing the use of only one electrical connector 512. In such embodiments or other embodiments having a receiving side metal trace, the one electrical connector 512 may be positioned in electrical communication with the metal trace(s) and have an OCA 506 seal the metal trace. In at least one embodiment, the OCA 506 may cover at least part of the electrical connector 512. In some embodiments, the OCA 506 may cover all of a surface of a touch film (not shown). The OCA 506 may be sized to have the same surface dimensions as the metal trace(s) and/or touch film.

[0043] FIG. 5-2 is a side cross-sectional view of the touch-sensing display 502 of FIG. 5-1 with a cover member 520. The stack of components includes a touch film 508 with at least one metal trace 510 between the touch film 508 and the cover member 520. The metal trace(s) 510 is in electrical communication with the electrical connector 512. A conductive element 518 is positioned between the electrical connector 512 and the metal trace(s) 510. In some embodiments, the conductive element 518 may be a conductive adhesive. For example, the conductive element 518 may be an anisotropic conductive adhesive. The metal trace(s) 510 is covered by the OCA 506 and sealed against corrosion

from environmental gases and/or fluids that may react with the metal trace(s) 510. For example, a metal trace(s) 510 including silver may be sealed such that it will not react with sulfur during manufacturing to form silver sulfide.

[0044] In some embodiments, the OCA 506 may cover and seal the metal trace(s) 510 up to the electrical connector 512. In other embodiments, such as shown in FIG. 5-2, the OCA 506 may overlap at least a portion of the electrical connector 512. For example, the OCA 506 may overlap and at least partially surround the electrical connector 512. The OCA 506 may at least partially surround the electrical connector 512 when the OCA 506 contacts at least a top surface of the electrical connector 512, as well as a front edge and the two side edges (as shown in plan view in FIG. 5-1). In other embodiments, the OCA 506 may deform around the front edge and/or side edges of the electrical connector 512 such that a portion of the OCA 506 may be positioned between the electrical connector 512 and the metal trace(s) 510 behind the conductive element 518. In at least one embodiment, the OCA 506 may contact the first electrical connector 512 on a top surface (further from the metal trace(s) 510), the front edge of the electrical connector 512, the side edges of the electrical connector 512, and a bottom surface (opposite the top surface and proximate the metal trace(s) 510).

[0045] FIG. 6-1 illustrates a transmission side of an embodiment of a touch film 608 as part of a touch-sensing display 602. The touch film 608 may have an OCA 624 that is positioned on less than a full surface area of the transmission side of the touch film 608. For example, the OCA 624 may cover less than 95% of the surface area of the transmission side of the touch film 608. In other examples, the OCA 624 may cover less than 90% of the surface area of the transmission side of the touch film 608. In yet other examples, the OCA 624 may cover less than 85% of the surface area of the transmission side of the touch film 608.

[0046] In some embodiments, the OCA 624 may cover all of a metal trace (such as metal trace 622 shown in FIG. 6-2). In other embodiments, the OCA 624 may cover less than all of the metal trace. For example, the OCA 624 may cover less than 95% of the surface area of the metal trace. In other examples, the OCA 624 may cover less than 90% of the surface area of the metal trace. In yet other examples, the OCA 624 may cover less than 85% of the metal trace.

[0047] In some embodiments, the OCA 624 may have a tab, porch, or other extension 632 that extends toward the electrical connector 614. In some embodiments, the extension 632 may protrude from an edge of the OCA 624. For example, the OCA 624 may be a rectangular sheet of OCA 624 with an extension 632 protruding from an edge of the rectangle. In other examples, the OCA 624 may be a polygonal sheet of OCA 624 with an extension 632 protruding from an edge of the polygon. In yet other examples, the OCA 624 may be a sheet of OCA 624 with a curved periphery with an extension 632 protruding discontinuously from an edge of the curved periphery (e.g., a rectangular extension 632 from an elliptical sheet of OCA 624). In yet other examples, the OCA 624 may be a sheet of OCA 624 with a curved periphery with an extension 632 protruding continuously from an edge of the curved periphery (e.g., a curved extension 632 from an elliptical sheet of OCA 624).

[0048] In some embodiments, the one electrical connector 614 may be positioned in electrical communication with the metal trace and the extension 632 may seal the metal trace. In at least one embodiment, the extension 632 and/or OCA 624 may cover at least part of the electrical connector 614. In some embodiments, the extension 632 and/or OCA 624 may cover all of a metal trace and less than a full surface of touch film 608. The extension 632 and OCA 624 may be sized to have the same surface dimensions and/or shape as the metal trace(s) and/or touch film.

[0049] FIG. 6-2 is a side cross-sectional view of the parts of a touch-sensing display 602 of FIG. 6-1. The stack of components includes a touch film 608 with at least one metal trace 622 positioned on the touch film. In at least one embodiment, the metal trace 622 may be a transmission metal trace (such as the second metal trace 422 described in relation to FIG. 4-2). The metal trace 622 is in electrical communication with the electrical connector 614. A conductive element 628 is positioned between the electrical connector 614 and the metal trace 622. In some embodiments, the conductive element 628 may be a conductive adhesive. For example, the conductive element 628 may be an anisotropic conductive adhesive. The metal trace 622 is covered by the OCA 624 and sealed against corrosion from environmental gases and/or fluids that may react with the metal trace 622. For example, a metal trace 622 including silver may be sealed such that it will not react with sulfur during manufacturing to form silver sulfide.

[0050] In some embodiments, an extension 632 and/or the OCA 624 may cover and seal the metal trace 622 up to the electrical connector 614. In other embodiments, such as shown in FIG. 6-2, the extension 632 and/or the OCA 624 may overlap at least a portion of the electrical connector 614. For example, the extension 632 and/or the OCA 624 may overlap and at least partially surround the electrical connector 614. The extension 632 and/or the OCA 624 may at least partially surround the electrical connector 614 when the extension 632 and/or the OCA 624 contacts at least a top surface of the electrical connector 614, as well as a front edge and the two side edges (as shown in plan view in FIG. 6-1). In other embodiments, the extension 632 and/or the OCA 624 may deform around the front edge and/or side edges of the electrical connector 614 such that a portion of the extension 632 and/or the OCA 624 may be positioned between the electrical connector 614 and the metal trace 622 behind the conductive element 628. In at least one embodiment, the extension 632 and/or the OCA 624 may contact the first electrical connector 614 on a top surface (further from the metal trace 622), the front edge of the electrical connector 614, the side edges of the electrical connector 614, and a bottom surface (opposite the top surface and proximate the metal trace 622).

[0051] FIG. 7 is a flowchart illustrating a method 734 of reducing corrosion of electrical connections in an electronic device. In some embodiments, the method 734 may include providing a metal trace on a surface of a touch film at 736. For example, the metal trace may include or be a silver metal trace. In other examples, the metal trace may include or be a copper metal trace. In yet other examples, the metal trace may include or be other metals. In at least one example, the metal trace may be another conductive material, such as ITO. In some examples, the touch film may be Polyethylene Terephthalate (PET). In other examples, the touch film may be another polyester material. In yet other examples, the touch film may include or be a polymer or other insulating material.

[0052] The method 734 may further include positioning an electrical connector in electrical communication with the metal trace at 738. The electrical connector may receive and detect changes in the voltage and/or current of the electricity in the metal trace. In some embodiments, the electrical connector may be a flexible printed circuit. The method 734 may further include applying an optically clear adhesive in contact with

at least a portion of the electrical connector 740. In some embodiments, the optically clear adhesive may cover all of the metal trace, sealing the metal trace from exposure to environmental gases and/or fluids that may corrode the metal trace. In at least one embodiment, the optically clear adhesive may cover all of the metal trace up to and abutting (i.e., contacting) the electrical connector without overlapping the electrical connector. Despite not overlapping the electrical connector, optically clear adhesive may seal all of the metal trace up to the electrical connector such that the metal trace is sealed against corrosion to maintain electrical conductivity of the metal trace to the electrical connector.

[0053] One or more specific embodiments of the present disclosure are described herein. These described embodiments are examples of the presently disclosed techniques. Additionally, in an effort to provide a concise description of these embodiments, not all features of an actual embodiment may be described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous embodiment-specific decisions will be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one embodiment to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

[0054] The articles "a," "an," and "the" are intended to mean that there are one or more of the elements in the preceding descriptions. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements. Additionally, it should be understood that references to "one embodiment" or "an embodiment" of the present disclosure are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. For example, any element described in relation to an embodiment herein may be combinable with any element of any other embodiment described herein. Numbers, percentages, ratios, or other values stated herein are intended to include that value, and also other values that are "about" or "approximately" the stated value, as would be appreciated by one of ordinary skill in the art encompassed by embodiments of

the present disclosure. A stated value should therefore be interpreted broadly enough to encompass values that are at least close enough to the stated value to perform a desired function or achieve a desired result. The stated values include at least the variation to be expected in a suitable manufacturing or production process, and may include values that are within 5%, within 1%, within 0.1%, or within 0.01% of a stated value.

[0055] A person having ordinary skill in the art should realize in view of the present disclosure that equivalent constructions do not depart from the spirit and scope of the present disclosure, and that various changes, substitutions, and alterations may be made to embodiments disclosed herein without departing from the spirit and scope of the present disclosure. Equivalent constructions, including functional “means-plus-function” clauses are intended to cover the structures described herein as performing the recited function, including both structural equivalents that operate in the same manner, and equivalent structures that provide the same function. It is the express intention of the applicant not to invoke means-plus-function or other functional claiming for any claim except for those in which the words ‘means for’ appear together with an associated function. Each addition, deletion, and modification to the embodiments that falls within the meaning and scope of the claims is to be embraced by the claims.

[0056] The terms “approximately,” “about,” and “substantially” as used herein represent an amount close to the stated amount that still performs a desired function or achieves a desired result. For example, the terms “approximately,” “about,” and “substantially” may refer to an amount that is within less than 5% of, within less than 1% of, within less than 0.1% of, and within less than 0.01% of a stated amount. Further, it should be understood that any directions or reference frames in the preceding description are merely relative directions or movements. For example, any references to “up” and “down” or “above” or “below” are merely descriptive of the relative position or movement of the related elements.

[0057] The present disclosure may be embodied in other specific forms without departing from its spirit or characteristics. The described embodiments are to be considered as illustrative and not restrictive. The scope of the disclosure is, therefore, indicated by the appended claims rather than by the foregoing description. Changes that

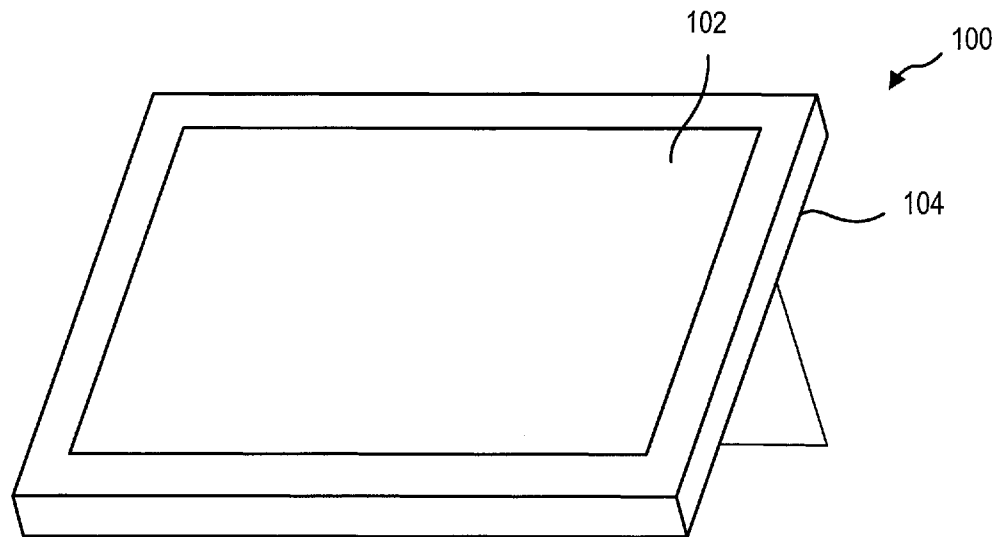
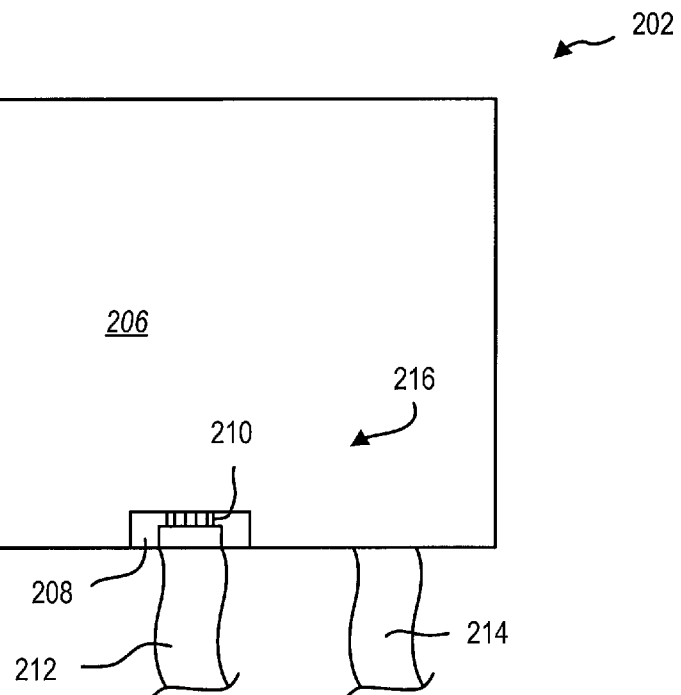
come within the meaning and range of equivalency of the claims are to be embraced within their scope.

WHAT IS CLAIMED IS:

1. An electronic device, the electronic device comprising:
a touch film having a metal trace positioned on a surface thereof;
an electrical connector positioned in contact with and providing electrical
communication with the metal trace; and
an optically clear adhesive contacting the metal trace and sealing an electrical
contact of the metal trace between the optically clear adhesive and the touch
film and sealing the electrical contact of the metal trace against environmental
corrosion.
2. The electronic device of claim 1, at least a portion of the optically clear adhesive
being positioned on a top surface of the electrical connector opposite the metal
trace, such that the electrical connector is between at least a portion of the
optically clear adhesive and at least a portion of the metal trace.
3. The electronic device of claim 1, further comprising a cover member adjacent to
the optically clear adhesive and opposite the touch film.
4. The electronic device of claim 1, all of the metal trace being positioned between
the optically clear adhesive and the touch film.
5. The electronic device of claim 1, the electrical connector being a flexible printed
circuit.
6. The electronic device of claim 1, the metal trace including silver.
7. The electronic device of claim 1, further comprising a conductive element
between the electrical connector and the metal trace.
8. The electronic device of claim 7, the conductive element being encapsulated by
the metal trace, the optically clear adhesive, and the electrical connector.

9. A touch-sensing electronic device, the touch-sensing electronic device comprising:
a touch film having a first metal trace positioned on a first surface thereof and a
second metal trace positioned on an opposite second surface thereof;
5 a first optically clear adhesive contacting the first metal trace and sealing an
electrical contact of the first metal trace between the first optically clear
adhesive and the touch film;
a second optically clear adhesive contacting the second metal trace and sealing an
electrical contact of the second metal trace between the second optically clear
10 adhesive and the touch film;
a first electrical connector positioned in contact with and providing electrical
communication with the first metal trace, the first electrical connector being at
least partially surrounded by the first optically clear adhesive; and
a second electrical connector positioned in contact with and providing electrical
15 communication with the second metal trace, the second electrical connector
being at least partially surrounded by the second optically clear adhesive.
10. The touch-sensing electronic device of claim 9, further comprising a cover
member adjacent to the first optically clear adhesive and opposite the touch film,
20 and a display screen adjacent to the second optically clear adhesive and opposite
the touch film.
11. The touch-sensing electronic device of claim 9, the first optically clear adhesive
sealing all of the first metal trace.
25
12. The touch-sensing electronic device of claim 11, the second optically clear
adhesive sealing all of the second metal trace.
13. The touch-sensing electronic device of claim 9, the second optically clear
30 adhesive having an extension, the extension being positioned in contact with and
providing electrical communication with the second metal trace.

14. The touch-sensing electronic device of claim 9, further comprising a first
conductive element between the first electrical connector and the first metal trace,
the first conductive element being encapsulated by the first metal trace, the first
5 optically clear adhesive, and the first electrical connector.
15. The touch-sensing electronic device of claim 9, further comprising a second
conductive element between the second electrical connector and the second metal
trace, the second conductive element being encapsulated by the second metal
10 trace, the second optically clear adhesive, and the second electrical connector.
16. A method of manufacturing an electronic device, the method comprising:
providing a metal trace on a surface of a touch film;
positioning the metal trace in electrical communication with an electrical
15 connector; and
applying an optically clear adhesive over the metal trace and electrical connector
such that the electrical connector is at least partially surrounded by the
optically clear adhesive.
- 20 17. The method of claim 16, further comprising sealing all of the metal trace with the
optically clear adhesive against environmental corrosion.
18. The method of claim 17, wherein the optically clear adhesive protects the metal
trace from sulfur.
- 25 19. The method of claim 16, further comprising passivating at least a portion of the
metal trace.
20. The method of claim 16, further comprising compressing the optically clear
30 adhesive to flow the optically clear adhesive around at least a portion of the
electrical connector.

**FIG. 1****FIG. 2-1**

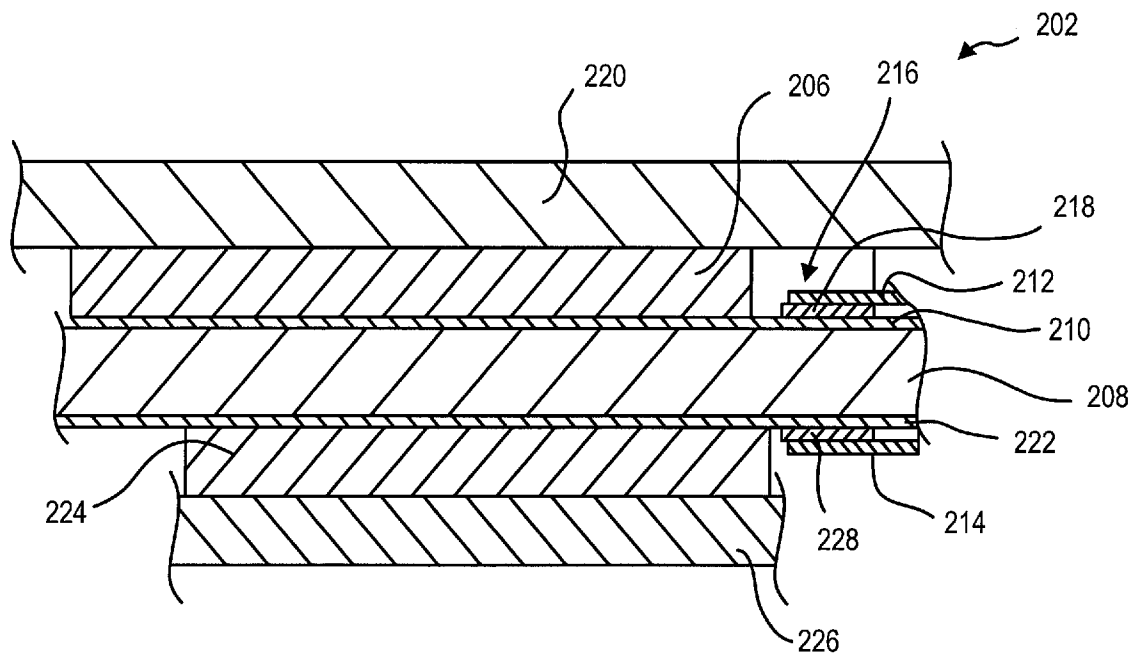


FIG. 2-2

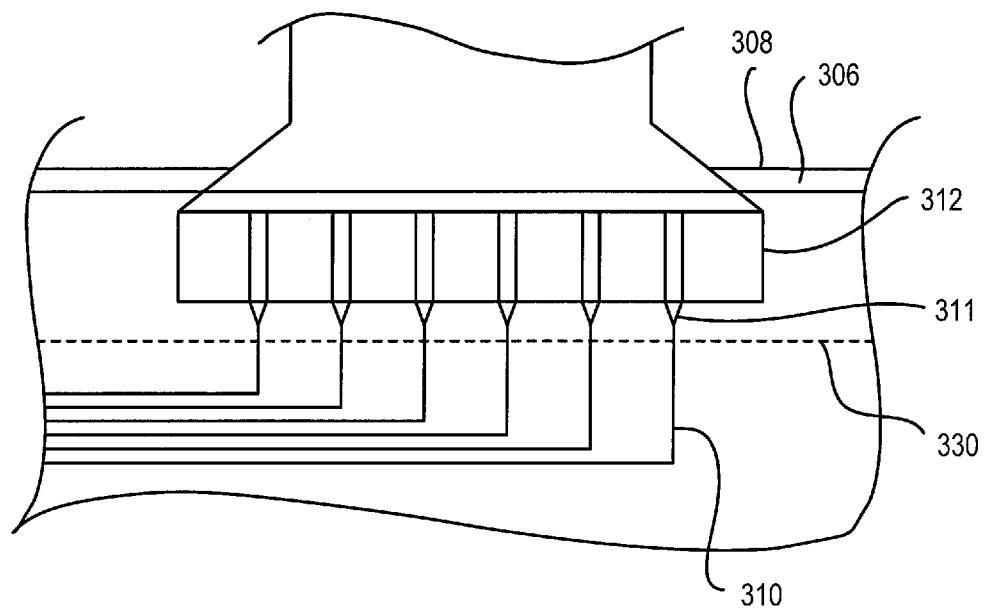


FIG. 3

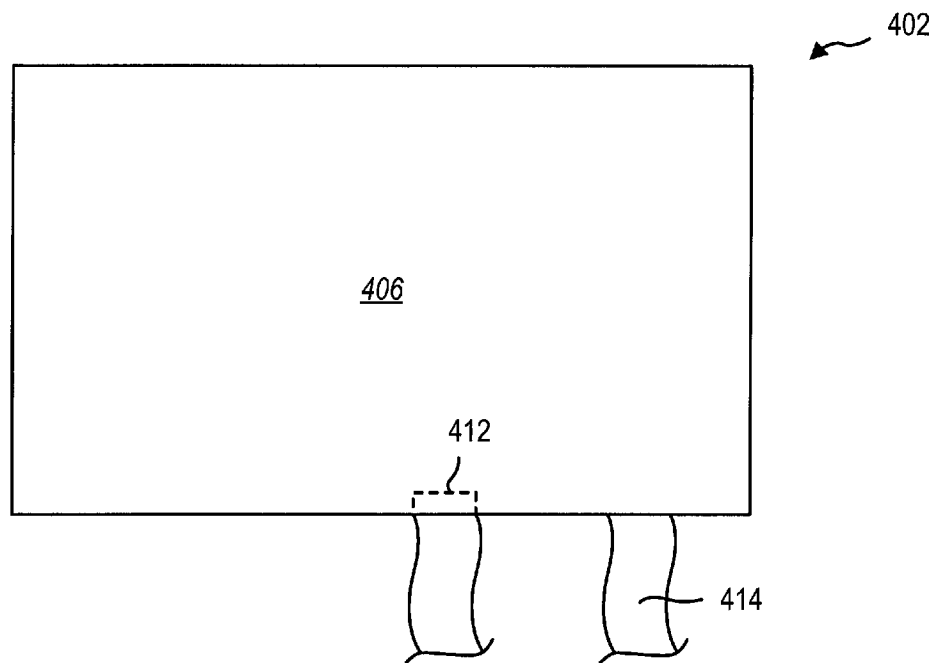


FIG. 4-1

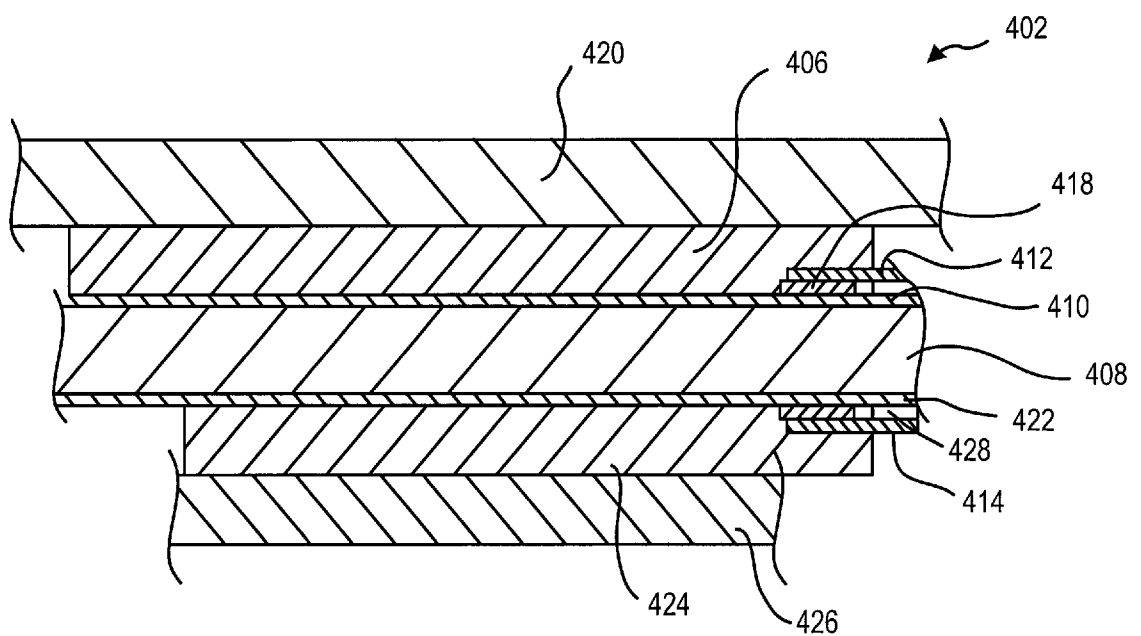


FIG. 4-2

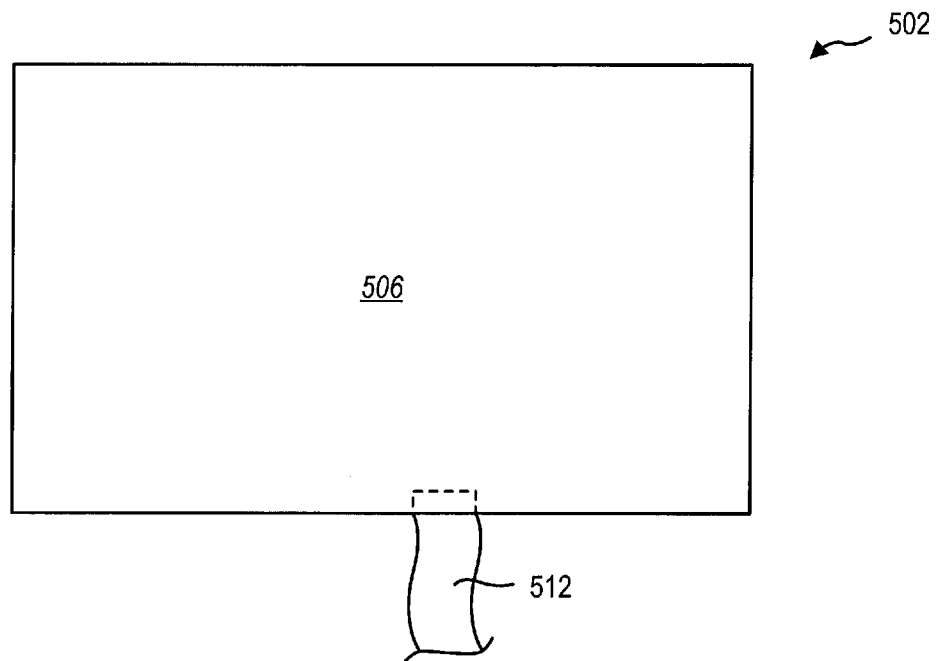


FIG. 5-1

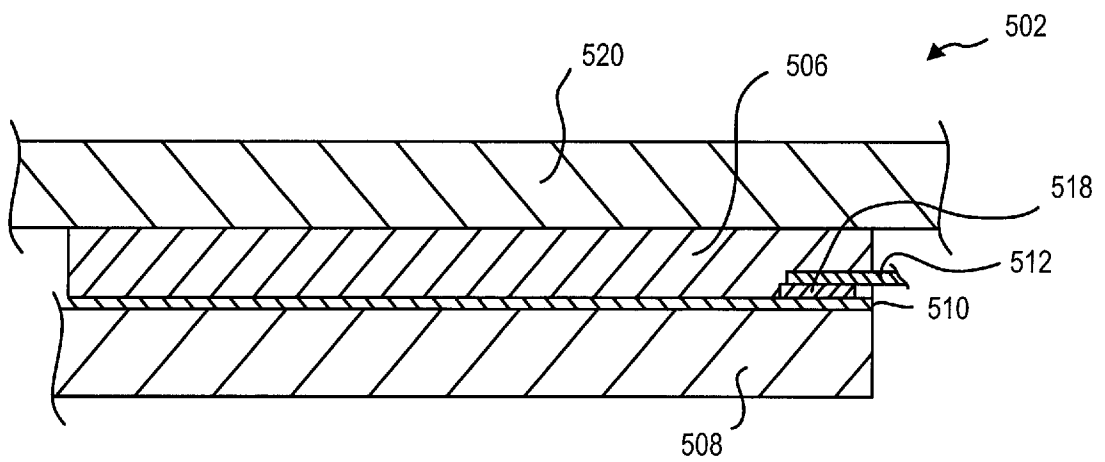
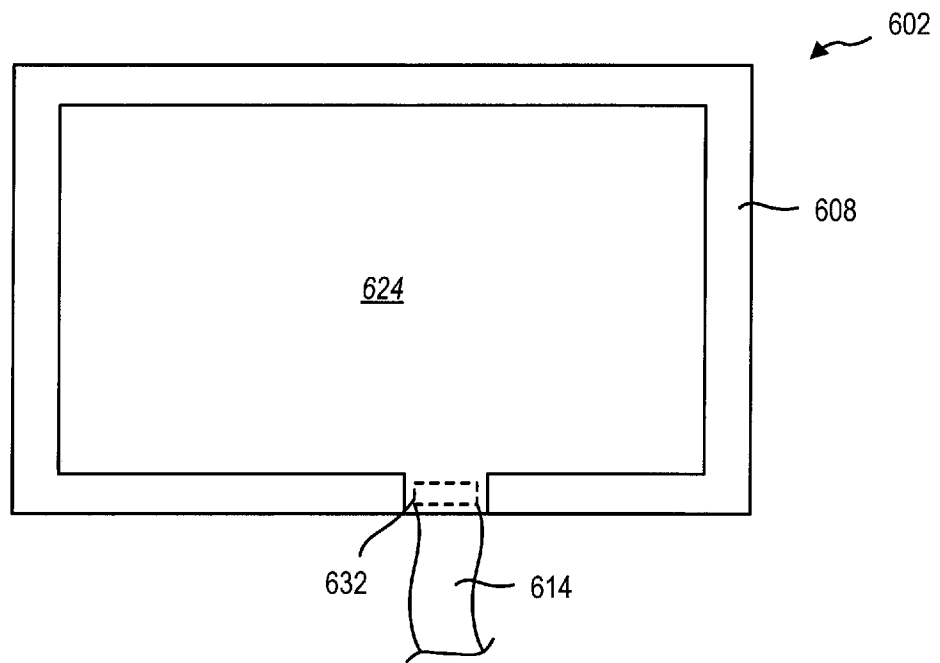
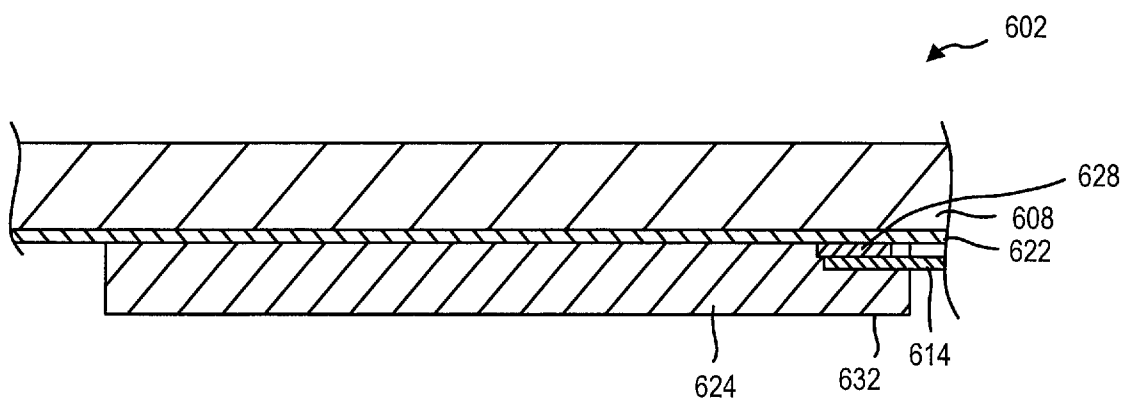
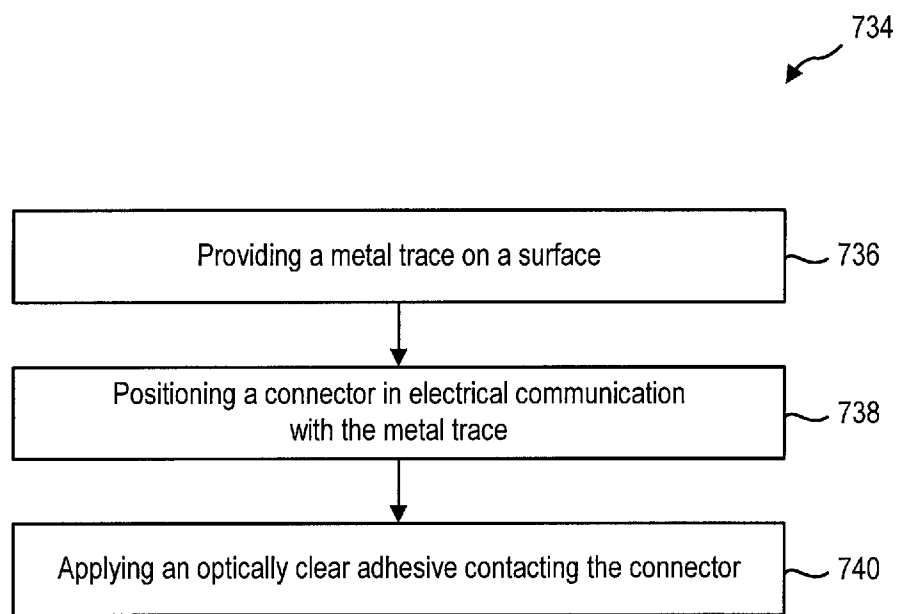


FIG. 5-2

**FIG. 6-1****FIG. 6-2**

**FIG. 7**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/082042

A. CLASSIFICATION OF SUBJECT MATTER

G06F 3/044(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)

G06F3/-;G02F1/-;H05K3/-

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

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

SIPOABS;CNABS;PATENTICS: touch+, screen, display, electrode+,metal w wire+,metal w trace+,connector+, terminal w block +, second+, two+, double+,corrosion+,erosion+, bond+,glue+,conglutinat+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 106126003 A (HITACHI CHEMICAL CO., LTD) 16 November 2016 (2016-11-16) description, paragraphs[0008]-[0201]and figures2-4	1-8, 16-20
Y	CN 106126003 A (HITACHI CHEMICAL CO., LTD) 16 November 2016 (2016-11-16) description, paragraphs[0008]-[0201]and figures2-4	9-15
Y	CN 104321693 A (APPLE INC.) 28 January 2015 (2015-01-28) description, paragraphs[0028]-[0084]and figures 1, 2, 11	9-15
A	CN 103827790 A (FUJI PHOTO FILM CO., LTD) 28 May 2014 (2014-05-28) the whole document	1-20
A	CN 105684177 A (APPLE INC.) 15 June 2016 (2016-06-15) the whole document	1-20
A	CN 102346610 A (SAMSUNG ELECTRO-MECHANICS CO.) 08 February 2012 (2012-02-08) the whole document	1-20
A	JP 2011028594 A (TOSHIBA MOBILE DISPLAY CO., LTD) 10 February 2011 (2011-02-10) the whole document	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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“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

25 December 2018

Date of mailing of the international search report

03 January 2019

Name and mailing address of the ISA/CN

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Facsimile No. (86-10)62019451

Telephone No. 86-(10)-53962865

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2018/082042

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				KR	20170106655	A	21 September 2017
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				WO	2013084883	A1	13 June 2013
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KR	101668939	B1	24 October 2016				
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				WO	2013047556	A1	04 April 2013
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				CN	105684177	A	15 June 2016
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				JP	2012027894	A	09 February 2012
JP	2011028594	A	10 February 2011	None			