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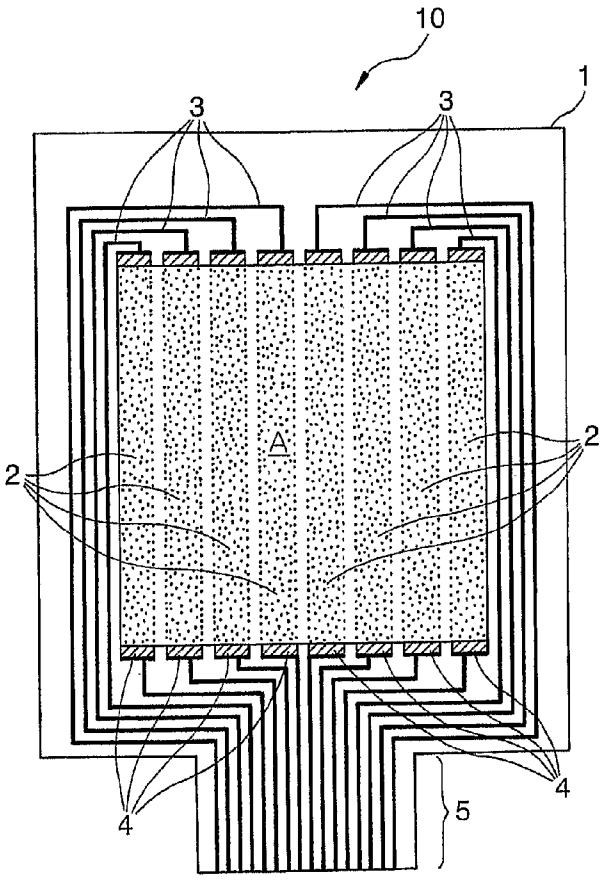
(54) Title: TOUCH PANEL SENSOR



(57) Abstract: The present invention discloses a touch panel sensor comprising: (a) a transparent flexible substrate, (b) a transparent conductive film formed on the transparent flexible substrate, (c) wiring composed of a metal or metal alloy, and (d) electrodes composed of conductive ink or paste for connecting the transparent conductive film (b) and the wiring (c).

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TOUCH PANEL SENSOR

The present invention relates to a touch panel sensor. More particularly, the present invention relates to a touch panel sensor that uses metal wiring but does not use an anisotropic conductive adhesive.

BACKGROUND

Touch panels are used as image display device-integrated input switches arranged on the front of image display devices, and are widely used due to their ease of use. There are various types of touch panels, examples of which include optical types, ultrasonic types, resistive film types, electrostatic capacitance types and piezoelectric types. A resistive film type of touch panel is most widely used due to its simple structure. A resistive film type of touch panel like that disclosed in, for example, Patent Document 1 (Japanese Unexamined Patent Publication No. 10-48625) is widely known which provides a transparent conductive film in the form of an ITO (indium tin oxide) film on two opposing transparent substrates, and electrically detects contact by that ITO film. In addition, electrostatic capacitance types of touch panels are known in, for example, Patent Document 2 (Japanese Unexamined Patent Publication No. 2003-66417), Patent Document 3 (US Patent No. 5,650,597) and Patent Document 4 (US Patent No. 6,819,316).

Normally, electrostatic capacitance type touch panels are arranged on an image display device (on the side of the operator). Consequently, electrostatic capacitance type touch panel sensors are provided with a transparent ITO film on the image display section. In addition, in electrostatic capacitance type touch panels, the touch panel sensor is connected to an electronic control board referred to as a controller that controls the touch panel. This controller is arranged on the back of the image display device (opposite side from the operator).

Since conventional touch panels have an ITO film coated onto a transparent glass substrate, a conductive paste having a high electrical conductivity such as silver is imprinted onto the ITO film, and wiring composed of a conductive paste is arranged on the glass substrate. This wiring is connected to a flexible wiring board by means of an anisotropic conductive adhesive at the edge of the glass substrate, and that flexible wiring

board is connected to the controller using a mechanical connector and so forth. Normally, a ZIF (zero insertion force) type of connector is used for the mechanical connector. In addition, this flexible wiring board attached to the touch panel is typically referred to as a "tail". However, touch panels employing this type of structure have the problems indicated below. Firstly, since an anisotropic conductive adhesive is used, connection reliability is inferior. Secondly, since the tail is in the form of a flexible wiring board having a polyimide for its support, it is expensive. Thirdly, since the process of forming the ITO film on the glass substrate is a batch process, it is difficult to increase the production speed.

Patent Document 4 (US Patent No. 6,819,316) proposes a sensor that forms an ITO film on a transparent, flexible organic substrate, and connects a controller to wiring composed of a conductive paste imprinted with silver paste and so forth that connects the ITO film without using an anisotropic conductive adhesive (tail-integrated sensor). Since this sensor does not use an anisotropic conductive adhesive, it has superior connection reliability. These sensors are normally produced in a roll-to-roll system, and after having cut out the sensor to a predetermined size, it is adhered with double-sided tape and so forth to a transparent support such as glass. However, the ZIF type of connectors used for ordinary controllers are clamped so as to scrape off the oxide film formed on the wiring material on the flexible substrate at the time of connection.

Consequently, although a touch panel using the technology described in Patent Document 4 (US Patent No. 6,819,316) is adequate under environmental conditions of ordinary consumer applications, in the case of using in environments subject to extremely severe vibrations, the wiring composed of imprinted conductive paste is scraped off by the ZIF type connector, and powder formed from the scraped off wiring has a high risk of dropping onto electronic components, thereby resulting in a higher risk of causing operational errors as compared with the case of using ordinary flexible wiring boards. Consequently, there is a need for a touch panel that offers a high level of connection reliability for the tail section.

The following indicates examples of means for providing an ITO film on a transparent substrate and wiring the ITO film. (1) A technology for providing an ITO film on a transparent substrate and coating a metal film such as Cu thereon by sputtering or plating is described in Patent Document 5 (US Patent No. 4,838,656) and Patent Document 6 (Japanese Unexamined Patent Publication No. 6-283261). (2) A technology for providing an ITO film on a transparent substrate and arranging a metal foil thereon with a conductive adhesive is described in Patent Document 7 (Japanese Unexamined Patent Publication No. 2002-270863). (3) A technology for providing an ITO film on a

transparent substrate, arranging a metal foil thereon with an adhesive, and connecting the metal foil and ITO film with conductive ink is described in Patent Document 8 (US Patent No. 5,679,176), Patent Document 9 (Japanese Unexamined Patent Publication No. 5-127153), Patent Document 10 (Japanese Unexamined Patent Publication No. 6-260265) and Patent Document 11 (Japanese Unexamined Patent Publication No. 11-524408).

However, the following problems arise when the aforementioned technologies are attempted to be applied to an electrostatic capacitance type of touch panel.

In the case of Patent Document 5 (US Patent No. 4,838,656), although the tail section of the touch panel sensor is ordinarily connected to the controller via a ZIF type connector, since a connection defect can arise if the metal film of the metal wiring of the tail section is too thin, the thickness is required to be 1 micron or more. In the case of Patent Document 5, if the thickness of the wiring metal is 1 micron or more, there is an extremely high risk of the ITO film also being etched simultaneous to etching of the wiring metal, thus resulting in the possibility of being unable to obtain an adequate ITO film. In addition, in the case of thin wiring, there is an extremely high possibility of the tail section breaking when bent resulting in a connection defect. Consequently, although it is necessary to thickly coat the wiring layer, this results in a longer coating time that prevents the touch panel sensor from being produced inexpensively.

In the case of Patent Document 6 (Japanese Unexamined Patent Publication No. 6-283261), when the flexible substrate serving as a base material is bent and adhered to a transparent support such as glass, cracks form easily at the level difference between the ITO film and metal wiring portion, thus resulting in a high risk of an increase in the contact resistance value with the ITO film. In Patent Document 6, since the board is used for a panel heater application, although an increase in the resistance value does not present a problem in terms of use, in touch panel applications, if the connection with the ITO film reaches a locally high resistance value, it is difficult to obtain correct touch information.

In Patent Document 7 (Japanese Unexamined Patent Publication No. 2002-270863), although the metal wiring is attached to the ITO film using a conductive adhesive, in order to apply this to a multiwired touch panel like that described in Patent Document 3 (US Patent No. 5,650,597), the adhered location of the metal wiring must be highly precise, which is difficult both technically and in terms of costs.

In Patent Document 8 (US Patent No. 5,679,176), Patent Document 9 (Japanese Unexamined Patent Publication No. 5-127153) and Patent Document 10 (Japanese Unexamined Patent Publication No. 6-260265), a metal foil is attached to an ITO film with an adhesive or double-sided insulated tape, and the metal foil and ITO film are connected electrically with conductive ink. Consequently, in environments subject to high

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