description of various embodiments of the invention in connection with the accompanying drawings, in which:

[0015] **FIG. 1** illustrates a schematic side view of a touch sensor in accordance with an embodiment of the invention;

[0016] **FIG. 2** illustrates a schematic three dimensional view of a touch sensor in accordance with another embodiment of the invention;

[0017] **FIG. 3** illustrates a schematic side view of a touch sensor in accordance with yet another embodiment of the invention;

[0018] **FIG. 4** illustrates a schematic side view of a display system in accordance with another embodiment of the invention;

[0019] **FIG. 5** illustrates a schematic three dimensional view of a touch sensor in accordance with an embodiment of the invention; and

[0020] **FIG. 6** illustrates a schematic side view of a touch display in accordance with another embodiment of the invention.

DETAILED DESCRIPTION

[0021] The present invention generally relates to sensing devices. The invention is particularly applicable to capacitive sensing devices, and even more particularly to capacitive touch sensors that have high durability.

[0022] Capacitive is a technology commonly used to detect the location of a touch input. In this case, a signal is generated when a conductive touch implement, such as a user's finger, is brought sufficiently close to a conductive film to allow capacitive coupling between the two conductors. The two conductors can be electrically connected to each other, for example, through the earth ground.

[0023] A capacitive touch sensor may be digital or analog. The touch sensitive area of a digital capacitive sensor can typically include a plurality of discrete electrically isolated conductive films. For example, the touch sensitive area may include a set of discrete touch pads. As another example, the touch sensitive area can include a plurality of electrically isolated parallel rows or columns of conductive films. In a digital capacitive touch sensor, the coordinates of a touch input can be determined by using discrete, or equivalently distinct, signals induced by the touch. In an analog capacitive touch sensor the touch sensitive area can be covered by an electrically continuous conductive film. In such a case, the signal induced by a touch input can include a signal that can assume a non-discrete, or equivalently, any one of a continuous set of possible values. In an analog capacitive touch sensor, the coordinates of a touch input can be determined by detecting and using the continuous signal induced by the touch. The accuracy of determining the touch location can be limited by the electronics used to process the induced signal.

[0024] A scratch in a conductive film in a capacitive touch sensor, particularly in an analog capacitive touch sensor, can lead to substantial inaccuracy in determining the location of a touch input. To guard against the occurrence of a scratch, the conductive film can typically be coated with a thin dielectric film, although some capacitive touch sensors may not have a dielectric coating. The dielectric film, however, may be too thin to protect the conductive film against abrasion due to normal use or, for example, a sharp touch implement. As such, there is a need for a highly durable capacitive touch sensor capable of withstanding abrasions with no or reduced degradation in the accuracy of determining a touch location.

[0025] According to one aspect of the present invention, a capacitive touch sensor includes a conductive film and a self-supporting flexible glass layer disposed on the conductive film. The glass layer is sufficiently thick to protect the conductive film against scratches and other extraneous factors. The glass layer is also sufficiently flexible to facilitate manufacturing of the sensor.

[0026] A touch sensor according to the present invention can advantageously be utilized in a number of applications. One such application is a touch display that is capable of including a signature capture area. Such a touch display may be used, for example, in a point of sale terminal, a security system or a check-out system where, for example, the signature of a customer can be captured and processed electronically during a credit transaction. The customer may sign his or her name with a recording instrument such as a pen, a stylus, or some other instrument capable of working with the touch display. The recording instrument can be active, meaning that it can be coupled to the touch display. For example, the recording instrument can be a stylus connected to the touch display via an electrically conductive wire. As another example, the recording instrument can be RF (Radio Frequency) coupled to the touch display. In general, the touch display can utilize any technology that would allow the recording instrument to communicate with the touch display. The capacitive touch sensor of the present invention can be substantially more durable than a conventional capacitive touch system in the application discussed above. The denser and substantially thicker glass of the present invention, compared to a conventional dielectric coating typically used in current analog capacitive devices, can provide significant protection for the conductive film against extraneous factors such as scratches that can be caused by, for example, normal use.

[0027] One or more embodiments of the current invention have particular utility in applications where it may be desirable to have a conductive film with high sheet resistance. Typically, a higher sheet resistance conductive film corresponds to a thinner film. As such, the film can become more susceptible to, for example, abrasions, which can adversely affect the accuracy of detecting a touch location. The current invention can provide significant protection for a high sheet resistance conductive film against scratches, abrasions, and other external factors. It will be appreciated that the sheet resistance of a conductive film may be changed, for example, increased, without changing the film thickness. For example, the sheet resistance may be increased by modifying the film composition. Even where a higher sheet resistance conductive film is not thinner than a lower sheet resistance conductive film, or a higher sheet resistance film is not more susceptive to external factors than a lower sheet resistance film, various embodiments of the present invention may be used to protect the conductive film against external factors.

[0028] As another application, the current invention can be used in a capacitive touch sensor where the conductive