[0043] An infrared touch screen detects touch position by determining beams of light in a grid of such light beams are interrupted by the touch. The grid of light is typically infrared light, and can be produced by an array of light emitting-diodes (LEDs) or by light sources that are waveguided and directed to form a grid. A series of phototransistor detectors, or a collector coupled to a detector, can be arranged to sense the light beams. Controller circuitry directs a sequence of light pulses, scanning the screen with a lattice of light beams just in front of the surface. When a touch is applied to the touch surface by a solid object, the infrared light beams are interrupted. Controller circuitry detects the location at which the light is obstructed.

[0044] **FIG. 6B** illustrates a SAW or infrared touch sensor employing the light control techniques according to one embodiment of the present invention. An optical control layer **660**, may be laminated or otherwise affixed on a rigid substrate **670**, such as glass, forming a structural element that provides the touch surface **650** of the touch sensor. A touch applied to the touch surface **650** is detected by transducers, such as SAW or IR transducers **680**. The touch location is determined by analyzing the signal changes detected by the transducers **680**. Another embodiment, illustrated **FIG. 6**C, shows the optical control layer **660** located on the opposite side of the rigid substrate **670**.

[0045] A process for manufacturing a touch sensor employing light control according to embodiments of the invention is illustrated in the flowchart of **FIG. 7**. In accordance with this embodiment, a substrate incorporating an optical control function is provided **710** as a supporting element **712** or as a touch surface **714** of the touch sensor. An active element of the touch sensor, which may comprise, for example, one or more conductive layers, or various transducers for determining the touch location are positioned **720** on the supporting element. Based on the touch sensing technology employed, additional coatings may be optionally applied to protect the active element of the touch sensor. Light directed through the touch sensor is controlled **730** by the optical control layer.

[0046] Various processes may be implemented to manufacture touch sensors using the touch sensing technologies described herein, or other known touch sensing techniques. **FIG. 8** is a flowchart illustrating an example process for manufacturing a capacitive touch sensor in accordance with an embodiment of the invention. According to this embodiment, a substrate incorporating a light control film (LCF substrate) is provided **810** as a structural element of a touch sensor.

[0047] An active element, for example a transparent conductive layer, is coupled **820** to the LCF substrate. One example for the preparation and application of a conductive layer is provided below.

[0048] In the case of capacitive touch sensors, for example, electrodes can be formed **830** on the conductive layer to provide connection between the conductive layer of the touch sensor and the controller. The capacitive touch sensor may be enhanced by the application of a resistive pattern to the conductive layer. The resistive pattern is configured to linearize the electric field imposed across the surface of the conductive layer by the controller.

[0049] Following formation of the electrodes a wiring harness can be connected **940** to the electrodes. A protective coating may be deposited **950** on the touch sensor.

[0050] A more detailed example of a manufacturing process that may be utilized to produce a capacitive touch sensor is provided below. The example embodiment provided below represents one process for manufacturing a light control touch sensor. Those skilled in the art will recognize that manufacture of the light control touch sensor is not limited to the example process provided herein.

[0051] A micro-louvered light control film substrate (available from **3**M Company under the trade designation LCF-P) was cleaned with de-ionized water.

[0052] A conductive polymer coating solution was prepared and then applied to the light control film substrate. The conductive polymer coating solution was prepared by mixing 1287.6 g of an aqueous dispersion of poly(3,4-ethylenedioxythiophene) polystyrene sulphonate (trade designation Baytron P, available from Bayer Corp.), 77.4 g of ethylene glycol, 27 g of 3-glycidoxypropyl trimethoxysilane, 1600.2 g of isopropyl alcohol, and 60 drops (applied from a pipette available under the designation SAMCO 212 pipette) of a fluorosurfactant (trade designation FC-171, 3M company). The mixture was stirred for 24 hours at room temperature then filtered to 5 μm before use. The conductive coating solution was applied to the substrate using a custom precision dip coater set to a withdrawal speed of 0.170 inches per second. The coated substrate was then cured at 85° C. for 6 minutes in a box furnace. A resistive material (available from DuPont under the designation 5089 Membrane Switch Compound) was then screen printed around the perimeter of the coated substrate to form a linearization pattern. The printed substrate was cured at 130° C. for 6 minutes.

[0053] A discrete wire electrical harness was connected to each of the four corners of the linearization pattern with conductive epoxy (Circuitworks CW2400) and cured at 120° C. for 6 minutes.

[0054] A protective coating solution for the touch sensor was made by mixing 87.5 g of a silicone modified polyacrylate (Silclean 3700 from BYK Chemical), 0.03 g of a 10% solution of dibutyltin dilaurate in propylene glycol methyl ethyl acetate, and 12.47 g resin solution (Desmodur L-75N from Bayer Corporation). This mixture was then diluted with 95 g propylene glycol methyl ethyl acetate. The solution was sprayed onto the touch screen and then cured at 66° C. for 1 hour.

[0055] The result was a flexible capacitive touch screen that included a conductive polymer as the signal sensing layer, the conductive polymer coated onto a light control film as the substrate. The light control film substrate allowed for viewing objects through the touch screen at normal and near normal incidences, and blocked viewing of objects through the touch screen at larger viewing angles.

[0056] The foregoing description of the various embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto.