TOUCH SCREEN STACK-UP PROCESSING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present invention claims the benefit under 35 USC 119(e) of U.S. provisional patent application Ser. No. 60/878,797 filed Jan. 5, 2007, the contents of which are incorporated by reference herein.

FIELD OF THE INVENTION

[0002] This relates to touch screens, and more particularly, to methods and processes for forming the stack-up of materials comprising the touch screens.

BACKGROUND OF THE INVENTION

[0003] Many types of input devices are presently available for performing operations in a computing system, such as buttons or keys, mice, trackballs, touch panels, joysticks, touch screens and the like. Touch screens, in particular, are becoming increasingly popular because of their ease and versatility of operation as well as their declining price. Touch screens can include a touch panel, which can be a clear panel with a touch-sensitive surface. The touch panel can be positioned in front of a display screen so that the touch-sensitive surface can cover the viewable area of the display screen. Touch screens can allow a user to make selections and move a cursor by simply touching the display screen via a finger or stylus. In general, the touch screen can recognize the touch and position of the touch on the display screen, and the computing system can interpret the touch and thereafter perform an action based on the touch event.

[0004] Touch panels can include an array of touch sensors capable of detecting touch events (the touching of fingers or other objects upon a touch-sensitive surface). Future panels may be able to detect multiple touches (the touching of fingers or other objects upon a touch-sensitive surface at distinct locations at about the same time) and near touches (fingers or other objects within the near-field detection capabilities of their touch sensors), and identify and track their locations. Examples of multi-touch panels are described in Applicants co-pending U.S. application Ser. No. 10/842,862 entitled "Multipoint Touchscreen," filed on May 6, 2004 and published as U.S. Published Application No. 2006/0097991 on May 11, 2006, the contents of which are incorporated by reference herein.

[0005] Various materials, adhesives, and processing steps are required to make a touch screen stackup that is functional, cost-effective, and space-efficient.

SUMMARY OF THE INVENTION

[0006] A multi-touch sensor panel can be produced by first forming a plurality of first traces of substantially transparent conductive material on a first substrate, forming a plurality of second traces of the substantially transparent material, and creating a fluid-tight gap between the plurality of first traces and the plurality of second traces. The fluid-tight gap can then be filled with a fluid having substantially no bubbles and an optical index similar to the optical index of the first and second traces to make the gap and the first and second traces substantially transparent. The second and first traces can be oriented to cross over each other at crossover locations separated by the fluid, the crossover locations forming mutual capacitance sensors for detecting touches.

[0007] In particular, a touch screen can be formed by first forming column traces on the back of a cover glass, forming row traces on the top of a substrate, and laminating the cover glass and substrate together with spacers in between, forming a fluid-tight gap. The fluid-tight gap can be filled with fluid having optical properties similar to the row and column traces. Integrated circuits (ICs) and flexible printed circuits (FPCs) can be bonded to the cover glass and encapsulated. The cover glass and substrate can further be bonded to an LCD module. Alternatively, both the column and row traces can be formed on the back side of the cover glass, separated by an insulator with dielectric properties.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIGS. **1***a* through **1***n* illustrate an exemplary first touchscreen that can be formed by combining an exemplary first upper layer subassembly, an exemplary first lower layer subassembly, and an exemplary LCD module according to one embodiment of this invention.

[0009] FIGS. **2***a* through **2***c* illustrate an exemplary second touchscreen that can be formed by combining the exemplary first upper layer subassembly, an exemplary second lower layer subassembly, and the exemplary LCD module according to one embodiment of this invention.

[0010] FIGS. **3***a* through **3***e* illustrate an exemplary third touchscreen that can be formed by combining the exemplary first upper layer subassembly, an exemplary third lower layer subassembly, and the exemplary LCD module according to one embodiment of this invention.

[0011] FIGS. **4***a* through **4***j* illustrate an exemplary fourth touchscreen that can be formed by an exemplary second upper layer subassembly and the exemplary LCD module according to one embodiment of this invention.

[0012] FIGS. **5***a* through **5***d* illustrate an exemplary fifth touchscreen that can be formed by an exemplary third upper layer subassembly and the exemplary LCD module according to one embodiment of this invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0013] In the following description of preferred embodiments, reference is made to the accompanying drawings which form a part hereof, and in which it is shown by way of illustration specific embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the preferred embodiments of the present invention.

[0014] It should be understood that in all of the figures and descriptions that follow, the listed materials, properties and dimensions (listed in units of millimeters unless otherwise noted) are merely exemplary in nature and are not intended to limit the scope of the invention.

[0015] FIGS. **1***a* through **1***n* illustrate an exemplary first touchscreen that can be formed by combining an exemplary first upper layer subassembly, an exemplary first lower layer subassembly, and an exemplary LCD module according to one embodiment of this invention. The exemplary first touchscreen of FIGS. **1***a*-**1***n* can also include force-sensitive touch screens.

[0016] FIGS. **1***a* through **1***c* illustrate an exemplary first upper layer subassembly for a touch sensor panel according to embodiments of the invention. FIG. **1***a* shows top glass or