CAPACITIVE TOUCH SENSOR WITH INTEGRAL EL BACKLIGHT

FIELD OF THE INVENTION

[0001] This invention relates to thick film electroluminescent (EL) lamps and, in particular, to an EL panel backlighting a capacitive touch sensor.

Glossary

[0002] As used herein, an EL "panel" is a single substrate including one or more luminous areas, wherein each luminous area is an EL "lamp." An EL panel can back-light plural capacitive switches but the lamps need not have a 1:1 correspondence with the switches.

[0003] A "thick film" EL lamp refers to one type of EL lamp and "thin film" EL lamp refers to a different type of EL lamp. The terms only broadly relate to actual thickness and actually identify distinct disciplines. A thin, thick film EL lamp is not a contradiction in terms and such a lamp is considerably thicker than a thin film EL lamp.

[0004] A "graphic" can be text, a symbol, an arbitrary shape, or some combination thereof. A graphic can be translucent, shaded, colored, a silhouette or outline, or some combination thereof.

[0005] A "phosphor layer" is not restricted to a single phosphor and does not exclude cascading phosphors or dyes for color enhancement.

[0006] "Ground" does not mean earth ground but means circuit ground or "common."

BACKGROUND OF THE INVENTION

[0007] An EL lamp is essentially a capacitor having a dielectric layer between two conductive electrodes, one of which is transparent. The dielectric layer includes a phosphor powder or there is a separate layer of phosphor powder adjacent the dielectric layer. The phosphor powder emits light in the presence of a strong electric field, using very little current.

[0008] A modern EL lamp is a thick film device, typically including a transparent substrate of polyester or polycarbonate material having a thickness of about 7.0 mils (0.178 mm.). A transparent, front electrode of indium tin oxide (ITO) or indium oxide is vacuum deposited onto the substrate to a thickness of 1000 Å or so. A phosphor layer is screen printed over the front electrode and a dielectric layer is screen printed over phosphor layer. A rear electrode is screen printed over the dielectric layer. Other methods for making an EL lamp can be used instead, e.g. roll coating.

[0009] The inks used for making an EL lamp include a binder, a solvent, and a filler, wherein the filler determines the nature of the printed layer. A typical solvent is dimethylacetimide (DMAC) or ethylbutylacetate (EB acetate). The binder is typically a fluoropolymer such as polyvinylidene fluoride/hexafluoropropylene (PVDF/HFP), polyester, vinyl, or epoxy. A front electrode can be vacuum deposited (sputtered) ITO or ITO particles in an ink. A phosphor layer is typically deposited from a slurry containing a solvent, a binder, and zinc sulphide particles. A dielectric layer is typically deposited from a slurry containing a solvent, a binder, and barium titanate ($BaTiO_3$) particles. A rear (opaque) electrode is typically deposited from a slurry containing a solvent, a binder, and conductive particles such as silver or carbon. Because the solvent and binder for each layer are chemically the same or similar, there is chemical compatibility and good adhesion between adjoining layers.

[0010] An EL lamp is used for backlighting switch pads and for backlighting displays because of the uniformity of the light. In a portable computer, cellular telephone, or other electronic device, a touch pad is often used as an interface for controlling the operation of the device. Typically, a touch pad includes a capacitive or resistive surface that is used to determine the position of a user's finger on the surface. Changes in resistance or capacitance are converted into a representation of the location of the touch. Many capacitive position sensors are disclosed in the art, e.g. U.S. Pat. No. 6,535,200 (Philipp). The Philipp patent discloses a "diaphanous" or "eggcrate-like" resistive layer/film made from "graphite-loaded paper" or "appropriate polymer based conductor." Although a broad range of resistivities is disclosed, 10^1 to 10^6 Ω/□, with a preferred resistivity "on the order of several tens of"Ω/□, it is not clear how to make the necessary resistive layer. U.S. Pat. No. 6,822,640 (Derocher) discloses using ITO as a conductive layer, does not disclose resistivity, but does disclose that the conductive layers are made from ink.

[0011] For EL panels, and especially for capacitive touch sensors, the conductive layers are critical to the operation of the device. A transparent, conductive layer of ITO sputtered onto a substrate are commercially available, which provides an economical way to obtain at least one electrode. The remaining electrodes are more expensive and more difficult to provide. As in any manufacturing process, the cost of a defect increases greatly as a product nears completion. Thus, there is a need not only to provide adequate conductive layers but to provide them as reliably and inexpensively as possible. Eliminating a conductive layer would be a great advantage.

[0012] It is known in the art to ground one layer of an EL lamp backlighting a capacitive touch sensor; e.g. see U.S. Pat. No. 6,822,640 (Derocher). It is also known to shield other electronics from an EL lamp with a grounded layer; e.g. see U.S. Pat. No. 5,486,738 (Saika et al.). There is no known disclosure of a unitary structure including touch sensor and an EL lamp backlighting the sensor. The structures of the prior art are stacked elements, which are necessarily relatively thick.

[0013] In view of the foregoing, it is therefore an object of the invention to provide an improved EL backlit, capacitive touch sensor.

[0014] Another object of the invention is to provide improved conductive layers for an EL backlit, capacitive touch sensor.

[0015] A further object of the invention is to provide a personal electronic device having a capacitive sensor backlit by an EL panel.

[0016] Another object of the invention is to provide an EL panel for backlighting a capacitive sensor serving as both a switchpad and a display; i.e. as both an input device and an output device.

[0017] A further object of the invention is to provide a unitary capacitive touch sensor backlit by an EL panel.