Abstract: A pressure sensor is configured and arranged for determining a characteristic of pressure applied to the sensor. The pressure sensor comprises a first electrode arrangement including a series of first conductive electrodes, the first conductive electrodes being disposed along a straight or curved virtual line. The pairs of next neighbors in the series of the first conductive electrodes are resistively interconnected in such a way that the series of first conductive electrodes has a finite electrical resistance between its extremal electrodes. An intrinsically pressure-sensitive organic layer is arranged along the virtual line in contact with the first conductive electrodes in such a way that, in response to pressure exceeding a predefined minimum pressure being applied to the pressure sensor, the intrinsically pressure-sensitive organic layer becomes at least locally conductive and causes those of the first conductive electrodes that lie at least partially in a region in which the applied pressure exceeds the predefined minimum pressure to become conductively interconnected.
PRESSURE SENSOR FOR MEASURING A CHARACTERISTIC OF A PRESSURE APPLIED TO THE SENSOR

Technical field

[0001] The present invention generally relates to pressure sensors and in particular to such sensors, which are configured and arranged for measuring a characteristic of a pressure applied to the sensor.

Background Art

[0002] Force or pressure sensors whose operation is based on conductivity of a special material depending on the applied force or pressure are known in the art. For instance, Ruben (U.S. patent 2,375,178) and Costanzo (U.S. patent 3,386,067) disclose a sandwiched structure enclosing a fibrous or sponge-like material containing conducting particles.

[0003] Mitchell (US patent 3,806,471) describes a switch based on a pressure responsive semiconductive composite material containing particles of molybdenum disulphide connected by an elastic binder material.

[0004] Eventoff (US patents 4,315,238 and 4,314,227) teaches a pressure sensor based on an elastic membrane that is deflected under the action of a pressure or force so as to establish an electrical contact between two electrodes through a thin pressure-sensitive layer. According to Eventoff, the pressure-sensitive layer may consist of 1 to 10 µm semiconductive particles (such as molybdenum disulphide) mixed with a binder material such as a resin. Such materials are presently available on the market and are used to produce stress sensors (see also Lalli, J.H et. al, Proc. SPIE 5758, 333 (2005)).

[0005] Another approach to pressure sensors has been disclosed by Anderson (U.S. patent 4,347,505). Anderson introduced a pressure sensing mat containing a thin, resiliently deformable sheet of semiconductor material having a pressure-independent intrinsic electrical conductivity. The sheet of semiconductor material is sandwiched between a pair of conductive electrodes, e.g. metal sheets. The surface of the semiconductor material has microscopic
ridges and depressions therein, which are deformed in the presence of applied pressure in such a way that the conductivity of the mat varies with pressure.

[0006] Force or pressure sensors according to Ruben, Costanzo, Mitchell and Eventoff rely on composite pressure-sensitive layers formed by an electrically insulating matrix material that contains conductive or semiconductive particles referred to as "pigment particles" in applications related to printing. The conductivity of such a composite pressure-sensitive layer increases as soon as two conditions are fulfilled. First, at least some of the conductive or semiconductive particles must be brought in a direct (i.e. geometrical) contact, thus forming electric contacts. Second, the particles in contact must form electric paths through the whole matrix material to electrically connect the electrodes flanking the composite pressure-sensitive layer. The first possibility is that the conductive paths through the whole matrix material exist without any pressure applied and that the number of such paths merely increases under applied pressure, thus leading to increased conductivity of the whole composite pressure-sensitive layer. The second possibility is that without any pressure applied, the electric paths do not exist and are only formed under pressure. The electrical conductivity is therefore related to the percolation phenomenon and the transition from the insulating to the conducting state takes place as soon as the percolation threshold of the composite material is achieved. Due to the well-known S-shaped characteristics of the dependence of the conductivity of the percolation medium on the concentration of conductive inclusions (see for example, Sahimi, M. *Applications of Percolation Theory* (Taylor&Francis Ltd., London, 1994)) the highest sensitivity with respect to pressure is exhibited in the vicinity of the threshold.

[0007] It is known, however, that a certain value of the percolation threshold is established as an average (with respect to an ensemble of samples) of the thresholds in different samples. The thresholds in any individual samples may significantly deviate from this average value.

[0008] In addition, the threshold depends on the shapes of the pigment particles. For this reason the threshold value differs from sample to sample in
systems in which the particles shapes are not well defined. At present, this is however, the case in all the industrial applications.

[0009] These reasons make it impossible to produce sensors with a precisely defined turn-on pressure based on the said composite pressure-sensitive layers. This represents a significant drawback peculiar to the approaches of Ruben, Costanzo, Mitchell and Eventoff.

[0010] There is another important drawback to the pressure sensors described above. In order to establish or to increase the conductivity through the composite pressure-sensitive layer sandwiched between two electrodes the particles must form conductive paths penetrating through the whole volume of the matrix and electrically connecting the said electrodes. This implies that multiple particles must inevitably stay in (or come into) a direct geometrical contact, such that their surfaces touch one another. Thus, multiple interfaces between the conducting particles and the insulating matrix participate in the conductivity. For this reason, the functioning of any device based on such a conducting/insulating composite is sensitive to the state of the said interfaces. Any corrosion or chemical modification of the surfaces of the particles as well as eventual splitting of the particles from the matrix of the composite gives rise to degradation of the device. This problem is referred to as the problem of "hidden surface".

[0011] In the following, the term "intrinsically pressure-sensitive organic layer" designates a layer comprising or consisting essentially of an organic material (e.g. a polymer, a blend of polymers or a non-polymeric organic material) that has an intrinsic (inherent) electrical conductivity that changes as a function of applied pressure. Such organic material is herein referred to as "intrinsically pressure-sensitive organic material". It is worthwhile noting that it is the intrinsic electric conductivity of the pressure-sensitive organic material that changes, i.e. the change in conductivity is due to changes on molecular level. This is in contrast to composite pressure-sensitive materials having electrically conductive particles embedded in an insulating matrix material. In the present context, a layer comprising or consisting essentially of intrinsically pressure-
sensitive organic material designates a layer, whose electrical properties are significantly, respectively essentially determined by the intrinsically pressure-sensitive organic material. For the present disclosure, an intrinsically pressure-sensitive organic layer should not be limited a priori to a layer consisting exclusively of intrinsically pressure-sensitive organic material. In addition to intrinsically pressure-sensitive organic material, an intrinsically pressure-sensitive organic layer may comprise other substances or molecules, e.g. inorganic or organic materials in general, polymers, oligomers, monomers, non-polymeric substances, e.g. molecules of organic conductors (such as, for instance, pentacene, conductive organic salts, etc.) or other organic molecules (such as e.g. phenolphthaleine, etc.). Such additives may help to adjust the properties of the intrinsically pressure-sensitive organic layer. The intrinsically pressure-sensitive organic layer has an electrical conductivity depending upon mechanical stress applied to the layer surface. In most practical applications, such stress is applied normally to the surface of the intrinsically pressure-sensitive organic layer (i.e. pressure). For reasons of conciseness, stress applied to the surface of the intrinsically pressure-sensitive organic layer is herein generally referred to as "pressure". One should nevertheless keep in mind that components of the stress tensor other than the normal components may cause the same effect.

[0012] The intrinsically pressure-sensitive materials discussed herein may be grouped into two different categories, according to the behaviour of the materials in response to pressure. The materials of the first group exhibit an abrupt, step like increase of the conductivity as a function of applied pressure. The materials of the second group exhibit an essentially continuous increase as a function of applied pressure, in a relatively broad pressure range.

[0013] For the materials of the first group, the curve representing the dependence of the conductivity of the intrinsically pressure-sensitive organic layer upon the applied pressure is essentially s-shaped. At low pressure values, the intrinsically pressure-sensitive organic layer exhibits a low conductivity (typical for insulators) and at high pressure values it exhibits a high conductivity (typical for semiconductors or metals, depending on the intrinsically pressure-
sensitive organic layer under consideration). The conductivity thus increases considerably within a certain, relatively narrow pressure interval (for polyphthalides, the increase in conductivity typically amounts to 6 to 9 orders of magnitude). It is convenient to characterize this pressure interval by two pressure values, which are herein referred to as "pressure thresholds". Below the lower or first pressure threshold, the intrinsically pressure-sensitive organic layer has the conductivity of an insulator; above the higher or second pressure threshold, the conductivity of the intrinsically pressure-sensitive organic layer is that of a semiconductor or a metal. Between the said first and second thresholds, the intrinsically pressure-sensitive organic layer undergoes a transition between the two conductivity states. Most of the intrinsically pressure-sensitive organic materials presently known (such as e.g. polydiphenilenephthalide) possess relatively narrow transition intervals, i.e. the difference between the second and the first pressure thresholds is smaller than the value of the first threshold. In this case, the intrinsically pressure-sensitive organic layer can be characterized by only one pressure threshold, \( P_{cr} \), chosen in the middle of the transition interval. In the vicinity of this pressure threshold \( P_{cr} \) the conductivity of such pressure-sensitive layer varies considerably (by 6 to 9 orders of magnitude in the case of polyphthalides), so that the conductivity as a function of pressure essentially behaves like a step function.

[0014] The materials of the second group have a slower transition from the insulating state to the conductive state. The transition between low conductivity and high conductivity may take place continuously in a relatively broad transition region (e.g. covering the entire working pressure range).

[0015] Intrinsically pressure-sensitive organic materials suitable in the context of the present invention have been disclosed, for instance, by A. N. Lachinov and S. N. Salazkin in RU 2 256 967 C1 or WO 2005/076289 A1, by Tsukagoshi et al. in US 2003/0178138 A1, by Miyadera et al. in JP 2002-241591 and by Tomono et al. in JP 2004-013451. Examples of intrinsically pressure-sensitive organic materials are the so-called polyphthalides. Structural formulas of the chemical composition of these polyphthalides can be found in the references just mentioned.
[0016] An intrinsically pressure-sensitive organic material usable in the intrinsically pressure-sensitive organic layers of pressure sensors is, for instance, poly(3,3'-phthalidyllidene-4,4'-biphenylene), a polymer which, if a pressure greater than the pressure threshold $P_{cr}$ is applied, exhibits high (metal-like) electrical conductivity in the direction of the compression (which is usually normal to the intrinsically pressure-sensitive organic layer), whereas the conductivity in the directions normal to the compression (i.e. usually parallel to the intrinsically pressure-sensitive organic layer) remains substantially lower (see e.g. Lachinov, et al. Synthetic Metals 57, 5046-51 (1993); Lachinov et al. Sov. Phys. JETP 75, 99-102 (1992); Lachinov et al. Synthetic Metals 41, 805-809 (1991)).


[0018] Intrinsically pressure-sensitive organic materials whose electrical conductivity substantially differs for different directions are herein referred to as "anisotropic intrinsically pressure-sensitive organic materials". These anisotropic materials include, for instance the above-mentioned polyphthalides, whose electrical conductivity increases in the direction of the compression, whereas the conductivity transversal to this direction remains low. The anisotropic materials also include material whose electrical conductivity increases only in a direction transversal to the direction of the compression. In contrast, intrinsically pressure-sensitive organic materials whose electrical conductivity changes substantially isotropically are referred to as "isotropic intrinsically pressure-sensitive organic materials". If not otherwise explained in the context, the term "intrinsically pressure-sensitive organic material" designates both isotropic and anisotropic intrinsically pressure-sensitive organic materials. If a distinction between these two types of intrinsically pressure-sensitive organic materials is
intended to be made, the specifications "isotropic" and "anisotropic" are used, respectively.

[0019] Any references cited hereinbefore are herewith incorporated herein by reference.

Object of the invention

[0020] It is an object of the present invention to provide an improved pressure sensor. The object a pressure sensor as claimed in claim 1.

General Description of the Invention

[0021] A pressure sensor is proposed that is configured and arranged for determining a characteristic of pressure applied to the sensor (e.g. the width of the region in which this pressure is applied and/or the position of this region and/or the amount of pressure applied etc.). The pressure sensor comprises a first electrode arrangement including a series of first conductive electrodes, the first conductive electrodes being disposed along a straight or curved (virtual) line. The pairs of next neighbors in the series of the first conductive electrodes are resistively interconnected (so that the first conductive electrodes are resistively connected in series along the straight or curved line) in such a way that the series of first conductive electrodes has a finite electrical resistance between its extremal electrodes. An intrinsically pressure-sensitive organic layer is arranged along the virtual line in contact with the first conductive electrodes in such a way that, in response to pressure exceeding a predefined minimum pressure being applied to the pressure sensor, the intrinsically pressure-sensitive organic layer becomes at least locally conductive and causes those of the first conductive electrodes that lie at least partially in a region in which the applied pressure exceeds the predefined minimum pressure to become conductively interconnected. The region in which the applied pressure exceeds the predefined minimum pressure is also referred to as the "activation region". In this region, the first electrodes are conductively interconnected through the intrinsically pressure-sensitive organic layer, which results in the finite electrical resistance between the extremal electrodes of the series being reduced as a
function of the number of conductive electrodes that overlap with the activation region. Those skilled will understand that the present invention works best with pressure-sensitive materials exhibiting a step-like increase in conductivity in response to increasing applied pressure.

[0022] According to a first variant of the invention, the intrinsically pressure-sensitive organic layer comprises an intrinsically pressure-sensitive polymer.

[0023] According to a second variant of the invention, the intrinsically pressure-sensitive organic layer comprises an intrinsically pressure-sensitive organic crystal or an intrinsically pressure-sensitive organic salt.

[0024] Preferably, the pressure sensor comprises one or more conductive shunt electrodes arranged in contact with the intrinsically pressure-sensitive organic layer in such a way that the intrinsically pressure-sensitive organic layer is sandwiched between the one or more shunt electrodes and the first conductive electrodes. In this configuration, when (sufficient) pressure is applied to the pressure sensor, the intrinsic electrical conductivity of the pressure-sensitive organic layer increases between one or more of the first electrodes and the shunt electrodes.

[0025] According to a preferred embodiment of the invention, the pressure sensor comprises a second electrode arrangement, the second electrode arrangement including a series of first conductive electrodes, which are conductively interconnected with one another. The second electrode arrangement is arranged coplanar with the first electrode arrangement and the second conductive electrodes are disposed in alternance with and spaced from the first conductive electrodes along the straight or curved virtual line. The intrinsically pressure-sensitive organic layer is arranged along the virtual line in contact with the first conductive electrodes and with the second conductive electrodes in such a way that, in response to pressure exceeding a predefined minimum pressure being applied to the pressure sensor, an electrical resistance decreases between those of the first conductive electrodes and those of the second conductive electrodes that lie at least partially in a region in which the applied pressure exceeds the predefined minimum pressure. By applying a
defined voltage drop across the series of first electrodes, and measuring the resulting voltage on the conductively connected second electrodes, one can e.g. find the location of the activation region.

[0026] In a preferred variant of this embodiment, the first conductive electrodes and the second conductive electrodes are configured as elongated conductive strips, the first and second conductive electrodes being arranged transversally with respect to the virtual line and in such a way that the first conductive electrodes interdigitate with the second conductive electrodes. The first and second conductive electrodes may, in particular, be arranged substantially in parallel. Such a pressure sensor may comprise one or more conductive shunt electrodes arranged in contact with the intrinsically pressure-sensitive organic layer in such a way that the intrinsically pressure-sensitive organic layer is sandwiched between the one or more shunt electrodes on the one side and the first and second conductive electrodes on the other side.

[0027] According to another preferred embodiment of the invention, the first conductive electrodes and the second conductive electrodes are configured as elongated, substantially parallel conductive strips arranged in interdigitating manner and the pressure sensor further comprises a third electrode arrangement and a fourth electrode arrangement. The third electrode arrangement is of similar configuration as the first electrode arrangement and includes a series of third conductive electrodes formed as substantially parallel elongated conductive strips, neighboring ones of the third conductive electrodes being resistively interconnected. The fourth electrode arrangement is similar to the second electrode arrangement and includes a series of fourth conductive electrodes formed as substantially parallel, elongated conductive strips, which are conductively interconnected with one another. The third electrode arrangement is arranged coplanar with the fourth electrode arrangement. The third and fourth conductive electrodes are in contact with the intrinsically pressure-sensitive organic layer so that the intrinsically pressure-sensitive organic layer is sandwiched between the first and second conductive electrodes on one side and the third and fourth conductive electrodes on the other side. Furthermore, the third conductive electrodes and the fourth conductive
electrodes are disposed substantially in parallel with respect to one another in such a way that the third conductive electrodes interdigitate with the fourth conductive electrodes and in such a way that, in addition to an electrical resistance decreasing between those of the first conductive electrodes and those of the second conductive electrodes that lie at least partially in a region in which the applied pressure exceeds the predefined minimum pressure, an electrical resistance decreases between those of the third conductive electrodes and those of the fourth conductive electrodes that lie at least partially in the region in which the applied pressure exceeds the predefined minimum pressure. Finally, the third and fourth conductive electrodes are arranged substantially non-collinear to the first and second conductive electrodes, so that, in addition to detecting a position of an activation region with regard to the series of first electrodes, one may also detect a position of an activation region with regard to the series of third electrodes. Preferably, in such a pressure sensor, the third and fourth conductive electrodes are arranged substantially perpendicular to the first and second conductive electrodes.

[0028] Advantageously, the pressure sensor comprises a (electrically insulating) substrate (e.g. a film, a foil or a plate) that carries the first and/or second conductive electrodes.

[0029] The intrinsically pressure-sensitive organic layer could be an isotropic intrinsically pressure-sensitive organic layer, or alternatively, an anisotropic intrinsically pressure-sensitive organic layer. As will become apparent to those skilled, in particular embodiments of the invention, one might have to choose one of these options. More details on this issue are given in the description of specific embodiments.

[0030] Preferably, the pressure sensor comprises a protective layer.

[0031] According to a particular variant of the invention, the pressure sensor comprises a membrane arranged substantially parallel to the intrinsically pressure-sensitive organic layer, the membrane being arranged and configured so as to deflect towards the intrinsically pressure-sensitive organic layer when pressure is applied to the pressure sensor, thereby reducing the pressure acting
on the intrinsically pressure-sensitive organic layer. The pressure is thus not applied directly to the pressure-sensitive layer but the reaction of the membrane compensates the pressure up to a certain pressure value. Above this threshold pressure, a part of the pressure is mechanically communicated to the intrinsically pressure-sensitive organic layer. In fact, the membrane serves to buffer the pressure. The membrane parameters can be dedicatedly chosen in order to achieve a desired sensitivity of the pressure sensor.

[0032] Adavntageously, the pressure sensor may comprise a luminescent layer emitting light in response to a current flowing through the luminescent layer or be connected in such a way in an electric circuit comprising a light emitting diode, as to influence the emission of light by the light-emitting diode.

[0033] The pressure sensor according to the present invention could, in principle, be integrated into any kind of electric appliance, e.g. a household device, a computer, a cell phone, a radio device, etc., as a human-appliance interface.

[0034] Those skilled will highly appreciate that the devices disclosed herein do not suffer from the problem of the "hidden surface" as exposed before. The intrinsically pressure-sensitive organic layer furthermore presents pressure thresholds that are stable in time.

[0035] Regarding manufacturing of a pressure sensors as described herein, it should be noted that any suitable methods could be used. The intrinsically pressure-sensitive organic layer may, for instance, be produced using a spin-coating method, a printing method, such as e.g. screen-printing, offset printing, gravure printing, flexography printing and/or inkjet printing, or any other deposition method. Though any suitable method may be used, inkjet printing is preferred, since it allows forming layers with a well-defined thickness between about 500 nm and a 5-10 µm in a single print and with pixel sizes of about 10 µm. Greater thickness may be achieved by using multiple prints. The achievable lateral resolution lies in the range of tens of µm (1 pixel may e.g. correspond to 75 µm). If the pressure-sensitive polymer disclosed in patent application WO 2005/076289 A1 is used as the intrinsically pressure-sensitive
organic layer, the thickness of the polymer layer is preferentially comprised in the range between 1 and 30 µm. For any of the printing methods, any suitable ink based on the pressure-sensitive material may be used. Such ink could comprise 0.5 to 5 wt.% of an intrinsically pressure-sensitive polymer, such as e.g. poly(diphenylenephthalide), poly(terphenylenephthalide), polyfluoronylephthalide, polyarylenesulfophthalide, or any other suitable intrinsically pressure-sensitive polymer, 95-99 wt.% of a solvent, such as e.g. cyclohexanone, nitrobenzene, chloroform or any other suitable solvent, and 0.001-0.1 wt.% of additives. Blends of intrinsically pressure-sensitive polymers as well as blends of one or more intrinsically pressure-sensitive polymers and other polymers can be used in the ink.

[0036] As concerns any conductive electrodes, conductive layers or conductive patterns, they could be made of bulk material (e.g. bulk metal), but preferably they are formed using methods such as e.g. metal evaporation or chemical precipitation or a printing process (such as e.g. screen-printing, off-set printing, gravure printing, flexography printing and/or inkjet printing). The conductive electrodes and layers might e.g. be formed by screen printing using conductive inks, such as e.g. Acheson Electrodag PF-007, Acheson Electrodag PF-046 or DowCorning PI-2000, or by inkjet printing using silver inkjet inks, e.g. Cabot AG-IJ-150-FX, Cima Nanotech IJ 242/21, Tetenal Silver Fluid UV, Harima Chem. NanoPaste or any other suitable inks.

[0037] As concerns resistive electrodes and resistive or resistive patterns, they may be formed of any suitable resistive bulk material or by using any suitable application process, e.g. screen-printing, offset printing, gravure printing, flexography printing and/or inkjet printing. Preferred resistive inks include, for instance, the Acheson Electrodag PF-407C, Nicomatic LtD C-100 or Nicomatic LtD C-200 inks for screen printing as well as, for instance, Tetenal UV Resistor LR, Tetenal UV Resistor MR, Tetenal UV Resistor HR carbon inks for inkjet printing.
The pressure sensors as discussed above may be carried on flexible, elastic or rigid substrates. In case of a printed device, the rigidity/flexibility of the substrate may determine to a large extent the rigidity/flexibility of the device.

**Brief Description of the Drawings**

Further details and advantages of the present invention will be apparent from the following detailed description of several not limiting embodiments with reference to the attached drawings, wherein:

- **Fig. 1** is a perspective view of a pressure sensor capable of detecting a diameter of an activation region;
- **Fig. 2** is a top view of the pressure sensor of Fig. 1;
- **Fig. 3** is a perspective view of a variant of a pressure sensor capable of detecting a diameter of an activation region;
- **Fig. 4** is a perspective view of another variant of a pressure sensor capable of detecting a diameter of an activation region;
- **Fig. 5** is a perspective view of yet another variant of a pressure sensor capable of detecting a diameter of an activation region;
- **Fig. 6** is a top view of a linear position sensor;
- **Fig. 7** is a cross sectional view of the linear position sensor along the line A-A of Fig. 6;
- **Fig. 8** is a cross sectional view of the linear position sensor along the line B-B of Fig. 6;
- **Fig. 9** is a top view of a variant of the linear position sensor of Figs. 6-8;
- **Fig. 10** is a cross sectional view of the linear position sensor along the line A'-A' of Fig. 9;
- **Fig. 11** is a cross sectional view of the linear position sensor along the line B'-B' of Fig. 9;
Fig. 12 is a top view of a position sensor for sensing the location of pressure in two dimensions;

Fig. 13 is perspective (phantom) view of a detail of the position sensor of Fig. 12

Fig. 14 is a cross sectional view of a shunt-mode pressure-sensitive switching element covered with an functionalizing or protective layer;

Fig. 15 is a cross sectional view of a pressure-sensitive switching element combined with an additional activation layer;

Description of Preferred Embodiments

[0040] Figs. 1-5 show different embodiments 70a-70d of a pressure sensor 70 that is suitable for detecting the diameter of an activation region (that is to say of the region within which a pressure is applied that exceeds the threshold necessary for making the intrinsically pressure-sensitive material conductive). Such a sensor 70 can e.g. be used in combination with an actuating member 72 whose contact surface with the pressure sensor 70 changes depending on the pressure it applies. An example of such an actuating member 72 is a human finger. The contact surface of the finger with a pressure sensor 70 increases with the pressure applied to the sensor because the fingertip resiliently deforms.

[0041] Those skilled will appreciate that once it is known how much the contact area between the actuating member 72 and the pressure sensor 70 changes as a function of the pressure applied, such pressure sensors 70 may also be used to determine the absolute value of the pressure applied. In case of the actuating member 72 is a human finger, since different people have fingers of different sizes and rigidities, preliminary measures, e.g. a personalized calibration, might be needed to enable such a pressure sensor 70 to measure an absolute value of the applied pressure. Though such measures are possible, they could make this particular use of the said button unpractical. In contrast, if the absolute value of the applied pressure is of lesser or no importance, the pressure sensor 70 does not require any preliminary calibration. For instance, the pressure...
sensor 70 can detect an initial drop of its electrical resistance, which accounts of the applied pressure exceeding the pressure threshold in a small region and a further decrease of its resistance accounting of an increase of the activation region, i.e. that region in which the applied pressure exceeds the pressure threshold.

[0042] With respect to Figs. 1 and 2, a pressure sensor 70a comprises, on a substrate 20, a series of substantially parallel, conductive, elongated electrodes 74. The electrodes 74 have substantially aligned first end portions 74.1, which are resistively interconnected in series by a stripe of resistive material 76 extending substantially perpendicular to the elongated electrodes 74. An intrinsically pressure-sensitive organic layer 16 is applied on the elongated electrodes 74 except on the first end portions 74.1 on which the stripe of resistive material 76 extends. The material of the intrinsically pressure-sensitive organic layer 16 is chosen such that the conductivity of the material increase at least for the directions transversal to the direction of the compression. The intrinsically pressure-sensitive organic layer 16 can e.g. be "isotropic" (as defined above) or "anisotropic" with a conductivity increasing in the plane of the layer 16. The layer 16 is spaced from the stripe of resistive material 76 and hence not in direct electric contact with it. The pressure sensor 70a is connectable to a measurement circuit by at least two electrical contacts on the stripe of resistive material 76. The pressure sensor shown in Figs. 1 and 2 has three contact points 76.1, 76.2, 76.3, by which the pressure sensor 70a is connectable to a measurement circuit (not shown). The first one of these electrical contact points, contact point 76.1, is located at the first end of the resistive stripe, the second one, contact point 76.2, at the second end portion of the resistive stripe. The third one of the electric contact points, contact point 76.3, is located substantially in the middle of the resistive stripe 76, i.e. at half way between the first and the second ends of the resistive stripe 76.

[0043] When sufficient pressure is applied to the pressure sensor 70a, e.g. by fingertip 72, the intrinsically pressure-sensitive organic material 16 becomes a conductor in the activation region, i.e. the region where the pressure exceeds the relevant threshold. As a consequence, the intrinsically pressure-sensitive
organic layer 16 shunts adjacent ones of the elongated electrodes 74 and thus a part of the resistive stripe 76. Although the applied pressure and the diameter of the activation region might continuously increase, the shunting occurs in a stepwise manner depending upon the number of elongated electrodes 74 that are covered by the activation region. This will in turn result in stepwise changes of the resistance between the end contact points 76.1 and 76.2. Likewise, the resistance between end contact point 76.1 and middle contact point 76.3 as well as between end contact point 76.2 and middle contact point 76.3, undergoes stepwise changes. Those skilled will note that measuring the electrical resistances between the middle contact point 76.3 and both end contact points 76.1, 76.2 allows a rough determination where the pressure has been applied.

In case the external pressure is applied substantially symmetrically with respect to the middle contact point, the electrical resistance between the middle contact point 76.3 and the end contact point 76.1 is substantially equal to the resistance between the middle contact point 76.3 and the other end contact point 76.2. If the pressure has been applied asymmetrically with respect to the middle contact point 76.3, e.g. towards one end contact point 76.1 or 76.2, the electrical resistance between this end contact point 76.1 or 76.2 and the middle contact point 76.3 will be lower than the resistance between the middle contact point and the other end contact point. Consequently, if it is known that the pressure is applied symmetrically with respect to the middle contact point 76.3, the diameter of the activation region can be determined by measuring between the middle contact point and one of the end contact points 76.1 and 76.2. This may for instance be the case in a pressure sensor 70a having some kind of indexing means indicating where the pressure has to be applied.

[0044] The pressure sensor represented in Figs. 1 and 2 allows determining the diameter of the activation region by measuring the electrical resistance between the end contacts 76.1 and 76.2. The spatial resolution that can be achieved depends on the spatial period Δ of the elongated electrodes. The spatial period Δ has to be smaller than the typical dimension of a region wherein the pressure is applied. Furthermore, the spatial period Δ has to be smaller than the smallest difference in diameter one wishes to detect. In Fig 2, for instance, one wants to
detect activation regions having at least diameter Di, the spatial period Δ has therefore been chosen inferior to Di. One furthermore wants to be able to distinguish an activation region of diameter D2 from an activation region of diameter Di, so the spatial period has also been chosen inferior to the difference D2-D1. The increase of the diameter of a contact area between a human finger and a pressure sensor in response to the applied pressure can be relatively small, so in some cases the spatial period Δ might lie in the sub-millimeter range (e.g. Δ = about 100 μm).

[0045] Another embodiment of a pressure sensor 70 for determining the diameter of an activation region is shown in Fig. 3. The pressure sensor 70b represented there can be implemented based on an isotropic or an anisotropic intrinsically pressure-sensitive organic layer 16, whose conductivity increases at least in the direction of the compression. The pressure sensor 70b comprises, on a substrate 20, a series of substantially parallel, conductive, elongated electrodes 74. The electrodes have substantially aligned first end portions 74.1, which are resistively interconnected by a stripe of resistive material 76 extending substantially perpendicular to the elongated electrodes 74. A layer of intrinsically pressure-sensitive organic material 16 is applied on the elongated electrodes 74 except on the first end portions 74.1, on which the stripe of resistive material 76 extends. The intrinsically pressure-sensitive organic layer 16 is spaced from the stripe of resistive material 76 and hence not in direct electric contact with it. A conductive shunt electrode 78 is arranged on top of the intrinsically pressure-sensitive organic layer 16. The pressure sensor 70b is connectable to a measurement circuit at a first contact point 78.1 on the conductive shunt electrode and a second contact point 76.2 at an end portion of the stripe of resistive material 76. The area to which the pressure should be applied is located at the end portion opposed to the end portion with the second contact point 76.2. A crosshair sign 80 indicates this area.

[0046] If no pressure is applied to the pressure sensor 70b, the intrinsically pressure-sensitive organic material is in an isolating state, and the resistance measured between the first and second contact points 78.1, 76.2 is practically infinite. As soon as a pressure exceeding the pressure threshold, above which
the intrinsically pressure-sensitive organic layer 16 is a conductor, is applied locally in the area indicated by the crosshair sign 80, the said pressure-sensitive material becomes conductive and those elongated electrodes 74 underneath the activation region are conductively connected to the shunt electrode 78 through the intrinsically pressure-sensitive organic layer 16. This results in a decrease of the resistance between the shunt electrode and contact point 76.2. Upon a further increase of the activation area, the number of elongated electrodes 74 shunted by the intrinsically pressure-sensitive organic layer 16 and the shunt electrode 78 also increases, which manifests itself by a further, stepwise decrease of the resistance between the shunt electrode and the contact point 76.2.

[0047] Yet another embodiment of a pressure sensor for determining the diameter of an activation region is shown in Fig. 4. The shown pressure sensor 70c comprises, on a substrate 20, a series of substantially parallel, conductive, elongated electrodes 74. An isotropic or anisotropic intrinsically pressure-sensitive organic layer 16 is arranged on the elongated electrodes 74. A resistive electrode 82 is arranged on the intrinsically pressure-sensitive organic layer 16. The resistive electrode 82 is connectable to a measurement circuit by its contact points 82.1 and 82.2, situated, respectively, on a front and a rear side of the pressure sensor 70c, seen in the direction of the elongated electrodes. In the absence of applied pressure, the resistance between the contact points 82.1 and 82.2 corresponds to the resistance of the resistive electrode 82. Those skilled will note that the conductive electrodes 74 could be replaced by any other electrode arrangement extending underneath the intrinsically pressure-sensitive organic layer 16 from the front to the rear side of the sensor; such an electrode arrangement could be a conductive grid, comb, a planar electrode, etc.

[0048] When sufficient pressure is applied to the pressure sensor 70c, e.g. by fingertip 72, the intrinsically pressure-sensitive organic material becomes a conductor in the activation region, i.e. the region where the pressure exceeds the relevant threshold. As a consequence, if the intrinsically pressure-sensitive organic layer 16 becomes conductive at least in the directions transversal to the
compression, it shunts the resistive electrode 82 in the activation region. The electrical resistance between the contact points 82.1, 82.2 thus varies inversely with the diameter of the activation region. If the intrinsically pressure-sensitive organic material is anisotropic and its conductivity increases only with respect to the direction of the compression, the resistive electrode is shunted in the activation regions by the elongated electrodes 74 that overlap with the activation region. Also in this case, the electrical resistance between the contact points 82.1, 82.2 drops with increasing diameter of the activation region.

[0049] The pressure sensors represented in Figs. 1-4 may comprise an additional flexible or elastic protection layer 84. Such a protection layer 84 could e.g. be made of a soft resin, a flexible polymer or any other suitable material. A pressure sensor 7Od equipped with such a protection layer is shown in Fig. 5. Due to the presence of the protection layer 84, the pressure applied to the pressure sensor 7Od may be redistributed over a larger area than it would be without the protection layer 84. Ultimately, this may increase the number of elongated electrodes 74 contributing to the pressure sensing. It may also result in a smoothening of the electrical response of the pressure sensor 7Od.

[0050] Figs. 6-8 show pressure sensor configured and arranged as a linear position sensor 56, with which the position of a local pressure P can be determined. Fig. 6 is a top view of the linear position sensor 56, which comprises, arranged on a same substrate, a second, conductive, comb-shaped electrode arrangement 58 and a first comb-shaped electrode arrangement 60, in such a way that the "teeth" (i.e. the elongated conductive electrodes 58.1) of the second electrode arrangement 58 and the teeth 60.1 of the first electrode arrangement 60 interdigitate without being in direct electric contact. The first comb-shaped electrode arrangement 60 has conductive teeth 60.1 and a resistive portion 60.2 interconnecting the conductive teeth 60.1 in such a way that there is a defined electrical resistance between two neighboring teeth 60.1. The teeth 58.1 of the second electrode arrangement are conductively interconnected so that they are substantially at the same electric potential.
[0051] As shown in Fig. 8, the resistive portion 60.2 of the first comb-shaped electrode arrangement 60 can be a layer of resistive material applied on the teeth 60.1 as a stripe extending substantially perpendicular to the teeth 60.1. Alternatively, the teeth 60.1 could also be applied on the layer of resistive material. It should be noted that the layer of resistive material does not extend into the region where the second and first comb-shaped electrode arrangements 58, 60 interdigitate. Hence, there is no direct electric contact between the second electrode arrangement 58 and the layer of resistive material, which forms here a resistive portion of the first electrode arrangement 60.

[0052] An intrinsically pressure-sensitive organic layer 16 is applied on the teeth 58.1, 60.1 of the second and first comb-shaped electrode arrangements 58, 60 in the region where the teeth 58.1, 60.1 interdigitate. This can be best seen in Figs. 6 and 7. If sufficient pressure P is exerted locally on the linear position sensor 56 as shown in Fig. 7, the intrinsically pressure-sensitive organic layer 16 turns conductive in the region where the pressure is applied, and an electric current may pass, in this region, between the teeth 58.1 of the second electrode arrangement 58 and the teeth 60.1 of the first electrode arrangement 60. Those skilled will note that, in the linear position pressure sensor 56, material of the intrinsically pressure-sensitive organic layer 16 has to be chosen among those materials that exhibit a conductivity increase perpendicular to the direction of compression.

[0053] The second electrode arrangement is connectable by its terminal 58.3 to a measurement circuit, while the stripe of resistive material is connectable to this circuit by its end point 60.3. The measurement circuit may for instance apply a potential difference between the terminal 58.3 and the end point 60.3 and measure the current that passes to determine the electrical resistance of the position sensor 56. When the local pressure is applied, the resistance of the position sensor 56 is essentially determined by the resistance of the layer of resistive material between the terminal 60.3 and the tooth of the first comb-shaped electrode arrangement that lies in the region of the applied pressure P.
As a consequence, the measured resistance indicates at which distance $d''$ from the end point the pressure $P$ is applied.

[0054] Those skilled will understand that for the position sensor 56 to work as intended, the distances between neighboring teeth and the widths of the teeth themselves have to be chosen smaller than the typical dimension of the region in which the pressure $P$ is applied. In case the pressure $P$ is applied by an actuating member, e.g. a fingertip, a pen tip etc, the distances between neighboring teeth and the widths of the teeth should be adapted to this actuating member, e.g. be chosen smaller than the diameter of that portion of the actuating member that comes into contact with the pressure sensor 56.

[0055] The resistive portion 60.2 of the first comb-shaped electrode arrangement 60 may be produced of any suitable material with a low conductivity, such as, for example, carbon (the resistivity of carbon inks used for screen printing is usually comprised in the range from 0.25 to 500 $\Omega$-cm), graphite, nichrome ($1.5 \times 10^{-4}$ $\Omega$-cm) and constantan (0.5 $\Omega$-cm). The electrode arrangements may be deposited by any printing method, by evaporation or any other suitable method; the conductive portions of the electrodes can be made of any suitable material, e.g. silver or copper. The intrinsically pressure-sensitive organic layer may be applied by a printing method, by a spin-coating method or any other suitable method. As will be appreciated, the proposed position sensor 56 is little sensitive to the possible presence of holes in the intrinsically pressure-sensitive organic layer. The position sensor may be covered with an additional protective layer.

[0056] Figs. 9-11 show another linear position sensor 56', by which the position of a local pressure $P$ can be determined. Indeed, the configuration of the position sensor of Figs. 9-11 is essentially the same as the one of the linear position sensor of Figs. 6-8, except that the position sensor 56' comprises, on top of the intrinsically pressure-sensitive organic layer, an additional conductive shunt electrode 62, preferably an elastic or flexible one, which at least partially overlaps with both the teeth of the second and the first comb-shaped electrode arrangements 58, 60. Owing to the shunt electrode 62, both anisotropic and
isotropic intrinsically pressure-sensitive organic layers 16 may be used in sensor 56'. If sufficient pressure P is exerted locally on the linear position sensor 56', the intrinsically pressure-sensitive organic material turns conductive in the region where the pressure is applied, and an electric current may pass, in this region, to the surface of the intrinsically pressure-sensitive organic layer. Hence, if sufficient pressure P is applied, a current may flow from a tooth 58.1 of the second comb-shaped electrode arrangement 58 through the intrinsically pressure-sensitive organic layer 16 to the shunt electrode 62, and from the shunt electrode 62 through the intrinsically pressure-sensitive organic layer 16 to a tooth 60.1 of the first comb-shaped electrode arrangement 60. In case of another pressure-sensitive material, the current could also flow directly from the teeth of the second electrode arrangement to the teeth of the first electrode arrangement. The distance d'' of the point of application of the pressure P from the contact point 60.3 may thus be determined.

[0057] Figs. 12 and 13 show a pressure sensor configured and arranged as a matrix position sensor 100, by which the position of a local pressure P can be determined in two dimensions. Fig. 12 is a top view of the matrix position sensor 100, which comprises, arranged on a same substrate 20 and in a bottom layer, a second, conductive, comb-shaped electrode arrangement 102 and a first comb-shaped electrode arrangement 104, in such a way that the teeth 102.1 of the second comb-shaped electrode arrangement 102 and the teeth 104.1 of the first comb-shaped electrode arrangement 104 interdigitate without being in direct electric contact. The first comb-shaped electrode arrangement 104 has conductive teeth 104.1 and a resistive portion 104.2 interconnecting the conductive teeth in such a way that there is a defined electrical resistance between two neighboring teeth 104.2. The teeth 102.1 of the second electrode arrangement 102 are conductively interconnected so that they are substantially at the same electric potential. The resistive portion 104.2 of the first comb-shaped electrode arrangement 104 is, in the case represented in Fig. 12, a layer of resistive material applied on the teeth 104.1 of the first comb-shaped electrode arrangement 104 as a stripe extending substantially perpendicular to the teeth 104.1. Alternatively, the teeth 104.1 could also be applied on the layer
of resistive material. It should be noted that the layer of resistive material does not extend into the region where the second and first comb-shaped electrode arrangements 102, 104 interdigitate and, hence, there is no direct electric contact between the second electrode arrangement 102 and the layer of resistive material of the first electrode arrangement 104.

[0058] The matrix position sensor further comprises, in a top layer, a fourth, conductive, comb-shaped electrode arrangement 106 and a third comb-shaped electrode arrangement 108, in such a way that the teeth 106.1 of the fourth comb-shaped electrode arrangement and the teeth 108.1 of the third comb-shaped electrode arrangement 108 interdigitate without being in direct electric contact. The structure of the third electrode arrangement 108 essentially corresponds to the structure of the first electrode arrangement 104, while the structure of the fourth electrode arrangement 106 essentially corresponds to the structure of the second electrode arrangement 102. The third comb-shaped electrode arrangement 108 has conductive teeth 108.1 and a resistive portion 108.2 interconnecting the conductive teeth 108.1 in such a way that there is a defined electrical resistance between two neighboring teeth 108.1. The teeth 106.1 of the fourth electrode arrangement 106 are conductively interconnected so that they are substantially at the same electric potential. The resistive portion 108.2 of the third comb-shaped electrode arrangement is, in the case illustrated, another layer of resistive material applied on the teeth 108.1 of the third comb-shaped electrode arrangement 108 as a stripe extending substantially perpendicular to the teeth 108.1. It should be noted that the layer of resistive material of the third electrode arrangement 108 does not extend into the region where the fourth and third comb-shaped electrode arrangements 106 and 108 interdigitate and, hence, there is no direct electric contact between the fourth electrode arrangement 106 and the layer of resistive material of the third electrode arrangement 108.

[0059] The region in which the teeth 106.1, 108.1 of the fourth and third comb-shaped electrode arrangements interdigitate is situated above the region in which the teeth 102.1, 104.1 of the second and first comb-shaped electrode arrangements 102, 104 interdigitate. Furthermore, the teeth 106.1, 108.1 of the
fourth and third comb-shaped electrode arrangements 106, 108 are oriented substantially non-collinear, preferably, as shown, perpendicular to the teeth 102.1, 104.1 of the second and first comb-shaped electrode arrangements 102, 104.

[0060] An isotropic or anisotropic intrinsically pressure-sensitive organic layer 16 is arranged sandwiched between the teeth 102.1, 104.1 of the second and first comb-shaped electrode arrangements 102, 104 in the region where their teeth interdigitate and the teeth 106.1, 108.1 of the fourth and third comb-shaped electrode arrangements 106, 108 in the region where their teeth interdigitate. This can be best seen in Fig. 13. If sufficient pressure is exerted locally on the matrix position sensor 100, the intrinsically pressure-sensitive organic material turns conductive in the region where the pressure is applied, and electric currents may pass, in this region, between the teeth 102.1 of the second electrode arrangement 102 and the teeth 104.1 of the first electrode arrangement 104 and between the teeth 106.1 of the fourth electrode arrangement 106 and the teeth 108.1 of the third electrode arrangement 108. If the intrinsically pressure-sensitive organic material is isotropic, a current may pass from the second electrode arrangement 102 to the first electrode arrangement 104, respectively from the fourth electrode arrangement 106 to the third electrode arrangement 108, directly through the polymer layer 16. If the intrinsically pressure-sensitive organic material 16 is anisotropic, in order to pass e.g. from the second electrode arrangement 102 to the first electrode arrangement 104, the current may pass from the second electrode arrangement 102 to either a tooth 106.1 of the fourth electrode arrangement 108 or a tooth 108.1 of the third electrode arrangement 108 and then from the latter to the first electrode arrangement 104.

[0061] The resistive stripe of the first electrode arrangement 104 can be connected to an electric measurement circuit by its contact points 104.3, 104.4 situated at the end portions of the resistive stripe. The resistive stripe of the third electrode arrangement 108 also has contact points 108.3, 108.4 situated at its end portions, by means of which it can be connected to an electric measurement circuit. The x-coordinate of a local pressure applied to the matrix
sensor can be determined by measuring the resistance between the second electrode arrangement 102 and one of the contact points of the resistive stripe of the first electrode arrangement 104. Analogously, the y-coordinate of the local pressure can be determined by measuring the resistance between the fourth electrode arrangement 106 and one of the contact points of the resistive stripe of the third electrode arrangement 108. Determining the x- and the y-coordinates of the applied pressure is hence achieved as in the linear position sensor discussed with respect to Figs. 6-8.

[0062] Preferably, as shown in Fig. 12, the second and the fourth electrode arrangements 102, 106 are conductively connected to each other so that they are at substantially the same electric potential.

[0063] Moreover, by measuring the resistance between the contact points 104.3 and 104.4 of the resistive stripe of the first electrode arrangement 104, the diameter in x-direction of the activation region, i.e. the region in which the local pressure exceeds the conductivity threshold of the intrinsically pressure-sensitive organic material 16, can be determined. Similarly, the diameter in y-direction of the activation region can be determined by measuring the resistance between the contact points 108.3 and 108.4 of the resistive stripe of the third electrode arrangement 108. Knowing the diameters in x- and y-direction, the area of the activation region can be estimated.

[0064] As can further be seen in Fig. 13, the matrix position sensor 100 may be covered with one or more protective and/or functionalizing elastic layers 110. A matrix position sensor 100 could be used, for instance in a touch screen, a mouse pad or any other device in which the position of a local pressure is to be determined with respect to two axes.

[0065] Fig. 14 shows, on a substrate 20, a linear position sensor as in Fig. 10 with an additional functionalizing or protective layer 38. The functionalizing or protective layer 38 can e.g. be applied by a spin coating method, by the printing methods mentioned above or by any other deposition method.

[0066] Fig. 15 shows a pressure sensor 40, similar to the one of Fig. 10, with an additional activation membrane 42. The pressure sensor 40 comprises a
substrate 20 and a flexible activation membrane, which are spaced from each other by a spacer 44. The spacer 44 has an opening 46 arranged therein, which accommodates the first and second electrode arrangements, the intrinsically pressure-sensitive organic layer 16 and the shunt electrode 62. When pressure is applied to the pressure sensor 40, the activation membrane 42 leaves its neutral position 48 and bends towards the substrate 20 in the active zone. When the applied pressure becomes high enough, the activation membrane 42 is brought into contact with the sandwiched structure of the first and second electrode arrangements, the intrinsically pressure-sensitive organic layer 16 and the shunt electrode 62. In turn, the sandwiched structure is subjected to part of the applied pressure. The external pressure \( P \) counterbalanced by the reaction of the activation membrane \( P_a \) and the reaction of the intrinsically pressure-sensitive organic material \( P_{psp} \) so that \( P = P_a + P_{psp} \). As soon as the pressure applied to the intrinsically pressure-sensitive organic layer 16 reaches a certain threshold \( P_{cr} \), the polymer goes into its conductive state. The overall turn-on point of the sensor \( Ptum-on \), \( i_{\beta} \), the external pressure at which the sensor 40 goes into the conductive state therefore takes the form \( Ptum-on = P_{a} + P_{cr} \), which is higher than that of the intrinsically pressure-sensitive organic material as such. The value \( Ptum-on \) can be adjusted in a controlled manner by variation of the reaction of the activation membrane 42, which can be achieved by varying the size and/or the geometry of the active zone, the thickness and/or the constitution of the activation membrane 42 as well as the height of the spacer 44.

[0067] While the present patent application as filed in principle concerns the invention as defined in the claims attached hereto, the person skilled in the art will readily understand that the present patent application contains support for the definition of other inventions, which could e.g. be claimed as subject matter of amended claims in the present application or as subject matter of claims in divisional and/or continuation applications. Such subject matter could be defined by any feature or combination of features disclosed herein.
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Claims

1. A pressure sensor for determining a characteristic of pressure applied to said sensor, comprising:
   a first electrode arrangement including a series of first conductive electrodes, said first conductive electrodes being disposed along a straight or curved virtual line, neighboring ones of said first conductive electrodes being resistively interconnected so that said series of first conductive electrodes has a finite electrical resistance,
   an intrinsically pressure-sensitive organic layer arranged along said virtual line in contact with said first conductive electrodes in such a way that, in response to pressure exceeding a predefined minimum pressure being applied to said pressure sensor, said intrinsically pressure-sensitive organic layer becomes at least locally conductive and causes those of the first conductive electrodes that lie at least partially in a region in which the applied pressure exceeds the predefined minimum pressure to become conductively interconnected.

2. The pressure sensor as claimed in claim 1, wherein said intrinsically pressure-sensitive organic layer comprises an intrinsically pressure-sensitive polymer.

3. The pressure sensor as claimed in claim 1, wherein said intrinsically pressure-sensitive organic layer comprises an organic crystal or an organic salt.

4. The pressure sensor as claimed in any one of claims 1 to 3, comprising one or more conductive shunt electrodes arranged in contact with said intrinsically pressure-sensitive organic layer in such a way that said intrinsically pressure-sensitive organic layer is sandwiched between said one or more shunt electrodes and said first conductive electrodes.

5. The pressure sensor as claimed in any one of claims 1 to 3, further comprising:
a second electrode arrangement, said second electrode arrangement including a series of second conductive electrodes which are conductively interconnected with one another;
wherein said second electrode arrangement is arranged coplanar with said first electrode arrangement, wherein said second conductive electrodes are disposed with said first conductive electrodes along said straight or curved virtual line in such a way that said first conductive electrodes are in alternance with said second conductive electrodes along said virtual line, wherein said intrinsically pressure-sensitive organic layer is arranged along said virtual line in contact with said first conductive electrodes and said second conductive electrodes in such a way that, in response to pressure exceeding a predefined minimum pressure being applied to said pressure sensor, an electrical resistance decreases between those of said first conductive electrodes and those of said second conductive electrodes that lie at least partially in a region in which said applied pressure exceeds said predefined minimum pressure.

6. The pressure sensor as claimed in claim 5, wherein said first conductive electrodes comprise elongated conductive strips, wherein said second conductive electrodes comprise elongated conductive strips and wherein said first and second conductive electrodes are arranged transversally with respect to said virtual line in such a way that said first conductive electrodes interdigitate with said second conductive electrodes.

7. The pressure sensor as claimed in claim 6, wherein said first conductive electrodes and said second conductive electrodes are arranged substantially in parallel in such a way that said first conductive electrodes interdigitate with said second conductive electrodes.

8. The pressure sensor as claimed in any one of claims 5 to 7, comprising one or more conductive shunt electrodes arranged in contact with said intrinsically pressure-sensitive organic layer in such a way that said intrinsically pressure-sensitive organic layer is sandwiched between said one or more shunt electrodes and said first and second conductive electrodes.
9. The pressure sensor as claimed in claim 5, wherein said first conductive electrodes are elongated conductive strips, wherein said second conductive electrodes are elongated conductive strips and wherein said first and second conductive electrodes are arranged substantially in parallel in such a way that said first conductive electrodes interdigitate with said second conductive electrodes; said pressure sensor further comprising a third electrode arrangement, said third electrode arrangement including a series of third conductive electrodes formed as substantially parallel elongated conductive strips, neighboring ones of said third conductive electrodes being resistively interconnected; a fourth electrode arrangement, said fourth electrode arrangement including a series of fourth conductive electrodes formed as substantially parallel elongated conductive strips which are conductively interconnected with one another; wherein said third electrode arrangement is arranged coplanar with said fourth electrode arrangement, wherein said third conductive electrodes and said fourth conductive electrodes are disposed substantially in parallel with respect to one another, in such a way that said third conductive electrodes interdigitate with said fourth conductive electrodes, wherein said third and fourth conductive electrodes are in contact with said intrinsically pressure-sensitive organic layer in such a way that said intrinsically pressure-sensitive organic layer is sandwiched between said first and second conductive electrodes on one side and said third and fourth conductive electrodes on the other side, in such a way that, in addition to an electrical resistance decreasing between those of said first conductive electrodes and those of said second conductive electrodes that lie at least partially in a region in which said applied pressure exceeds said predefined minimum pressure, an electrical resistance decreases between those of said third conductive electrodes and those of said fourth conductive electrodes that lie at least partially in said region in which said applied pressure exceeds said predefined minimum pressure;
and wherein said third and fourth conductive electrodes are arranged substantially non-collinear to said first and second conductive electrodes.

10. The pressure sensor as claimed in claim 9, wherein said third and fourth conductive electrodes are arranged substantially perpendicular to said first and second conductive electrodes.

11. The pressure sensor as claimed in any one of claims 1 to 10, comprising a substrate that carries said first and/or second conductive electrodes.

12. The pressure sensor as claimed in any one of claims 1 to 11, wherein said intrinsically pressure-sensitive organic layer is an isotropic intrinsically pressure-sensitive organic layer.

13. The pressure sensor as claimed in any one of claims 1 to 12, wherein said intrinsically pressure-sensitive organic layer is an anisotropic intrinsically pressure-sensitive organic layer.

14. The pressure sensor as claimed in any one of claims 1 to 13, comprising a protective layer.

15. The pressure sensor as claimed in any one of claims 1 to 14, comprising a membrane arranged substantially parallel to said intrinsically pressure-sensitive organic layer, said membrane being arranged and configured so as to deflect towards said intrinsically pressure-sensitive organic layer when pressure is applied to said pressure sensor, thereby reducing the pressure acting on said intrinsically pressure-sensitive organic layer.

16. The pressure sensor as claimed in any one of claims 1 to 15, comprising a luminescent layer emitting light in response to a current flowing through said luminescent layer.

17. The pressure sensor as claimed in any one of claims 1 to 16, connected in an electric circuit comprising a light emitting diode in such a way as to influence the emission of light by the light-emitting diode.

18. An electric appliance comprising a pressure sensor as claimed in any one of claims 1 to 17.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01L1/20

According to International Patent Classification (IPC) or to both national classification and IPC.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B60R GOIL G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C

See patent family annex

* Special categories of cited documents

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Date of the actual completion of the international search

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Date of mailing of the international search report

10/07/2007

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