Supplementary Information

Fully Printed Minimum Port Flexible Interdigital Electrode

Sensor Arrays

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We conducted an electrical insulation cycle experiment. It is verified by experiments that the electrical connection between the upper and lower layers of the electrode is reliable under the three-dimensional layer-by-layer insulation stacking mode. Figure S1 shows that there is no electrical connection between the two electrodes when the insulating ink is screen printed between the upper and lower electrodes and is pressed for 20,000 times under a force of 50 kPa. The thickness of the sensitive layer is affected by many factors, such as ink characteristics, screen printing parameters, ambient temperature, humidity, ink knife angle and so on. Therefore, the consistency of the thickness of the sensitive layer cannot be guaranteed, and the depth of the microstructure cannot be known. Nonetheless, the quantity of laser engravings can take the place of the depth value. Different laser engraving times cause different microstructure depths. We took measurements of the sensor performance curve when the number of laser engraving is 0, 5, 10, 15 and 20 times. The experiment demonstrates that the number of laser engravings is different, resulting in different microstructure depths, but it has little effect on the performance of the pressure sensor, the sensor performs poorly if the sensitive layer is not laser etched. The sensor performance is reasonably near and falls within the permitted error range when the sensitive layer is laser engraved 5, 10, 15, and 20 times. It is impossible to guarantee the constancy of the sensitive layer's thickness because it depends on a variety of conditions. As a result, the sensitive layer's microstructure depth is chosen for this investigation when it has been totally penetrated by 20 rounds of laser engraving.



Fig. S1 Performance test. **(a)**Electrical insulation performance test image. **(b)** 20,000 cycles of experimental data graph. **(c)** Effect of microstructure depth of sensitive layer on pressure performance of sensor.



Fig. S2 SEM image of bottom electrode of interdigital array. (a) - (d) are SEM images of 50 μ m, 20 μ m, 1 μ m, 500 nm resolution.



Fig. S3 SEM images of the sensitive layer of the sensor. (a) - (d) are SEM images of 200 μ m, 100 μ m, 1 μ m, 500 nm resolution.



Fig. S4 Bottom electrode EDS layered image. **(a)** The energy dispersive X-ray spectrometer was used to analyze the images of "C", "Ag", "O" and "N" elements in the electrode layer. **(b)** The electrode layer analyzes the image of the "C" element. **(c)** The electrode layer analyzes the image of "Ag" element. **(d)** The electrode layer analyzes the image of "O" element. **(e)** The electrode layer analyzes the image of "N" element.



Fig. S5 EDS layered image of sensitive layer. **(a)** The "C", "O" and "N" elements in the sensitive layer were analyzed by EDS. **(b)** The sensitive layer analyzes the image of "C" element. **(c)** The sensitive layer analyzes the image of "N" element. **(d)** The sensitive layer analyzes the image of "O" element.

The sensing unit is fixed to a beaker with a specific radian in the strain experiment (Fig S6a). At this point, mechanical deformation generates the associated strain. The data diagram showing how strain affects sensor response is found in Figure S6b. The figure shows that the strain alters the sensor response by around 0.02 μ A. This value is significantly less than the pressure sensor's response value upon detecting a change in pressure, indicating that the strain's impact on the response can be disregarded, multi-signal decoupling is not required for the sensor.



Fig. S6 The influence of strain on the performance of the sensor is tested. **(a)** Diagram of strain test. **(b)** Data diagram of the influence of strain on sensor response.

To observe how humidity impacted the response of the sensor, the humidity levels in which the sensors in the humidity experiment (Fig S7) were put were 11%, 33%, 43%, 58%, and 76%, respectively. As the humidity rises, the sensor response will progressively get stronger. The response increases with humidity and the amount of time needed to reach a steady state reduces as humidity rises. The humidity has a negligible impact on the sensor response, with a maximum response variation of around 0.03 µA. On the other hand, humidity has little effect on the sensor's performance, as shown by the sensitivity diagram of the sensor corresponding to each humidity (Fig S7f), and the sensitivity data of various humidity fall within the permitted error range. (The error curve is shown in Figure 4a.) Accordingly, multi-signal decoupling is not required for the sensor.



Fig. S7 The influence of humidity on sensor performance. (a) - (e) Data diagram of the influence of different humidity on sensor response. (f) An experimental data chart comparing the performance of sensors at varying humidity levels.

In the temperature experiment, we contrasted the sensor's response and sensitivity data at 10, 30, 50, 70, and 90 degrees Celsius. Figure S8 shows that when the temperature rises from 10 °C to 50 °C, the sensor's response increases by roughly 0.003 μ A. At 70 °C and 90 °C, the response curve of the sensor first rises and then falls to a stable level. The temperature rising is to blame for this, as it causes the sensor to respond more strongly. But as the humidity drops and the moisture in the sensor unit evaporates, the sensor's response is diminished. The sensor response experiences an increase of around 0.005 μ A in its final stable condition. It can be concluded that the influence of temperature on the sensor response is weak and negligible. On the other hand, the temperature has little effect on the performance of the sensor. As shown in the sensitivity diagram of the sensor corresponding to each temperature (Fig. S8f), the sensitivity data of various humidity fall within the allowable error range. (The error curve is shown in Figure 4a.) Therefore, multi-signal decoupling is not required for the sensor.



Fig. S8 The influence of temperature on sensor performance. **(a)** - **(e)** Data diagram of the influence of different temperature on sensor response **(f)** Comparison of experimental data charts for sensor performance at various temperatures.



Fig. S9 The mechanical arm was tested with 20 kinds of pulse data, including firm pulse, feeble pulse, tense pulse, long pulse, wiry pulse, weak pulse, floating pulse, small pulse, intermittent pulse, short pulse, rapid pulses, full pulse, swift pulse, tremulous pulse, tympanic pulse, infrequent pulse, weak-floating pulse, hollow pulse, deep pulse and hidden pulse.

Monitoring the pulse signal of traditional Chinese medicine, because the pulse signal is extremely weak and the position of the pulse signal is difficult to find, the pressure sensor array in this paper has excellent sensitivity, the pressure sensor array can monitor the weak signals at multiple signal points at the same time, which can easily cover the position of the pulse signal and overcome the problem that the strongest point of the pulse signal is difficult to find. At the same time, we conducted a pressure distribution test. The hand-held beaker's pressure distribution test and heat map of pressure distribution are shown in Figures S10a, b. The center of force when gripping the beaker is located between the thumb and the index finger. The center of the heat map indicates where the maximum pressure is located. Plantar pressure distribution test and pressure distribution heat map of human standing are shown in Figures S10c, d. When standing, the center of the force is the foot's center line, and the sensor array is positioned at the heel of the foot. As shown in the heat map, the force in the middle of the sensor array is large, and the force on both sides is small. The sensor array's multi-point monitoring capability is demonstrated by both experiments.



Fig. S10 Test of sensor pressure distribution. **(a)** The hand-held beaker's pressure distribution test and **(b)** heat map of pressure distribution. **(c)** Plantar pressure distribution test and **(d)** heat map of pressure distribution.