

Thin and flexible force sensor

Thin, highly integrated sensor capable of measuring low stress range

Overview

Measurement of shear stress and contact stress provides important information in various fields such as robotics, medical, digital, and direct skin contact product development. Conventional triaxial stress sensors have thick and rigid shapes, so it has been difficult to directly measure shear stress and contact stress in vivo, for example.

In order to solve the above problems, the inventor has developed the following sensors.

1. Patent No. JP5688792 * Related Patent (2/4)

Thin sensor capable of measuring shear stress and contact stress simultaneously

2. Patent No. JP6753615 * Related Patent (3/4)

Highly integrated sensor technology

3. Patent No. JP7466214 * Related Patent (4/4)

A laminated sensor capable of measuring even in a low stress range based on the principle of 1.

The present invention is a thin, highly integrated sensor combining the above technologies. Demonstration experiments for various applications have been conducted, and the practical application of this technology is expected.

Product Application

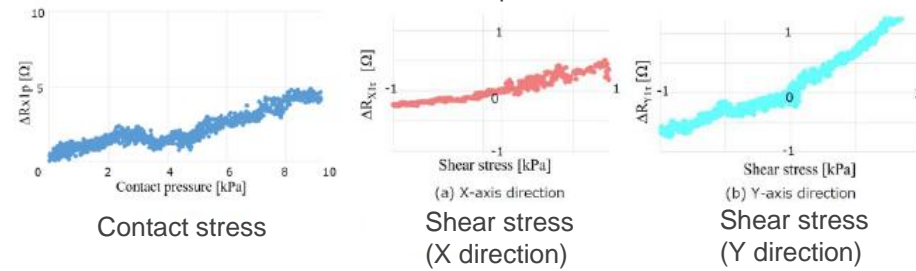
- ❑ Robot sensor, Digital touch panel sensor, and medical sensor
- ❑ Evaluation of texture and softness in product development
- ❑ Visualization and transmission of skilled techniques based on force perception
- ❑ Wearable device such as foot pressure distribution, etc.

IP Data

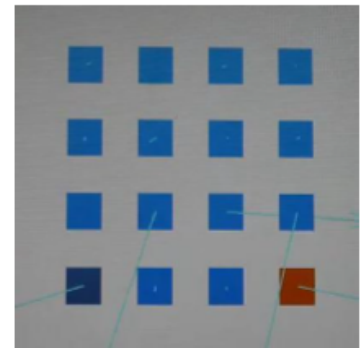
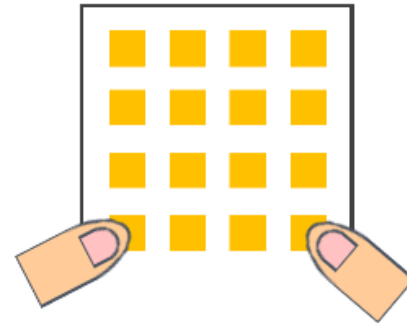
IP No. : JP2024-038393
 Inventor : SASAGAWA Kazuhiko
 Admin No. : K23-030

Related patents (1/4)

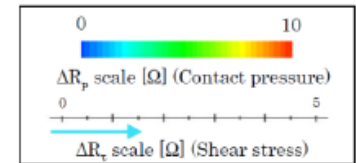
Results of calibration experiments



Verification experiments of the present invention



The triaxial stress distribution is measured when vertical and lateral stresses are applied to two points of the sensor with fingers.



Related Works

[1] Presentation materials for the 2023 Kita-Tohoku Three University- Measurement and Environment-New Technology Briefing, sponsored by JST (Japanese only)

Contact

Sensor for simultaneous measurement of shear and pressure

Shear stress and contact stress can be measured simultaneously with high accuracy

Overview

In order to measure shear stress and contact stress, there is a conventional method of measuring shear stress due to shear deformation of a sensor pressure sensitive element. However, in this method, the influence of contact pressure becomes an error, and accurate measurement is difficult.

The present invention has developed a method capable of directly and simultaneously measuring shear stress and contact pressure with high accuracy. The sensor of the present invention is thin (150 μm or less) and soft, and can directly and simultaneously measure, for example, shear stress and contact pressure in a living body.

Product Application

- ❑ Robot sensor, Digital touch panel sensor, and medical sensor
- ❑ Evaluation of texture and softness in product development
- ❑ Visualization and transmission of skilled techniques based on force perception
- ❑ Wearable device such as foot pressure distribution, etc.

IP Data

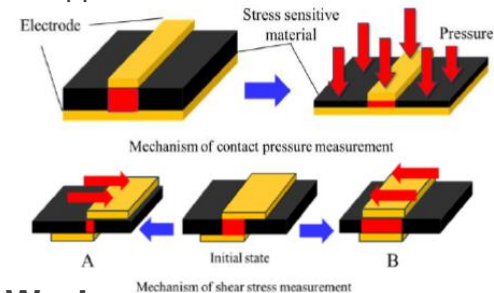
IP No. : JP5688792
 Inventor : SASAGAWA Kazuhiko
 Admin No. : K23-011



Sensors developed in the present invention

Measurement principle of the present invention

- Upper and lower electrodes are arranged across a pressure-sensitive conductive sensing layer.
- Changes in electrical resistance between upper and lower electrodes due to electrode displacement when contact pressure or shear stress is applied are measured.



Related Works

- [1] Film sensor for triaxial contact stress measurements on the human body, Mechanical Engineering Letters, 9, 22-00309(2023)
- [2] Measurement of contact stress between clothing and skin using thin and flexible triaxial stress sensor, Journal of Biomechanical Science and Engineering, 17(4), 22-00149(2022)

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Matrix distributed sensor device

Highly integrated capable of arranging many sensors with a small number of wires

Overview

The inventor's prior art Patent No. 5688792 (* Related Patent (2/4)) successfully developed a thin sensor that can directly and simultaneously measure shear stress and contact pressure with high accuracy. However, the arrangement of multiple conventional sensors requires the arrangement of many wires, which makes integration difficult.

The present invention is a sensor with high spatial resolution that can arrange multiple sensors with a simple design. Specifically, the sensor has a structure that can sequentially scan measurement points by arranging many conventional sensors in a matrix and designing a circuit with common wiring ; therefore, a 3-axis stress measurement sensor has been developed that can realize a small size and high integration.

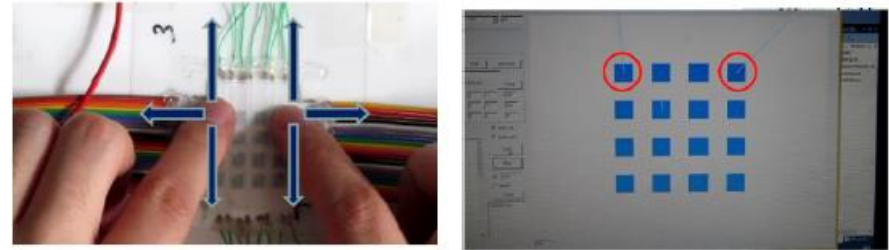
Product Application

- ❑ Robot sensor, Digital touch panel sensor, and medical sensor
- ❑ Evaluation of texture and softness in product development
- ❑ Visualization and transmission of skilled techniques based on force perception
- ❑ Wearable device such as foot pressure distribution ,etc.

IP Data

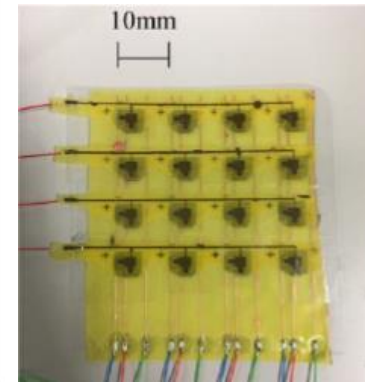
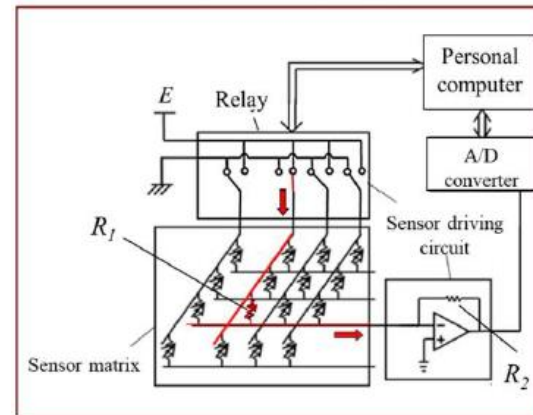
IP No. : JP6753615
 Inventor : SASAGAWA Kazuhiko
 Admin No. : K23-022

Example of application with multiple sensors: Touch panel



Structure and principle of the present invention

Sequential measurement by relay control



Related Works

[1] Development of Contact Pressure and Shear Stresses Sensor for Touch Panel, JSME Mechanical Engineering Letters, 4, 18-00257(2018)

[2] Development of Thin and Flexible Contact Pressure Sensing System for High Spatial Resolution Measurements [Sensors and Actuators A, 263, pp.610-613(2017)

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Layered sensor

Thin, flexible, highly sensitive sensor

Overview

The inventor's prior art Patent No. 5688792 (* Related Patent (2/4)) is a thin and flexible sensor that can directly measure shear stress and contact pressure of an object. However, the conventional sensor has a structure in which upper and lower electrodes are bonded together, and the upper and lower electrodes do not adhere to each other. Therefore, there is a problem that measurement accuracy under low stress is inferior.

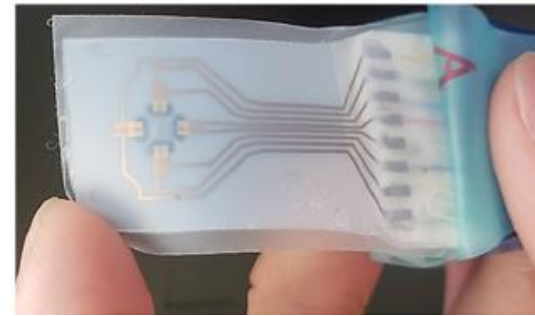
To solve the above problem, we have developed a laminated sensor that can stably measure under low stress of 1KPa (10gf/cm²) or less. Since the present invention uses a lamination process, manufacturing with reduced dispersion is possible. In addition, since the lower electrode, the stress sensitive layer, and the upper electrode are laminated in close contact with each other, highly sensitive measurement is possible, and high spatial resolution can be expected because of miniaturization and high integration by photolithography.

Product Application

- ❑ Robot sensor, Digital touch panel sensor, and medical sensor
- ❑ Evaluation of texture and softness in product development
- ❑ Visualization and transmission of skilled techniques based on force perception
- ❑ Wearable device such as foot pressure distribution ,etc.

IP Data

IP No. : JP7466214
 Inventor : SASAGAWA Kazuhiko
 Admin No. : K24-002

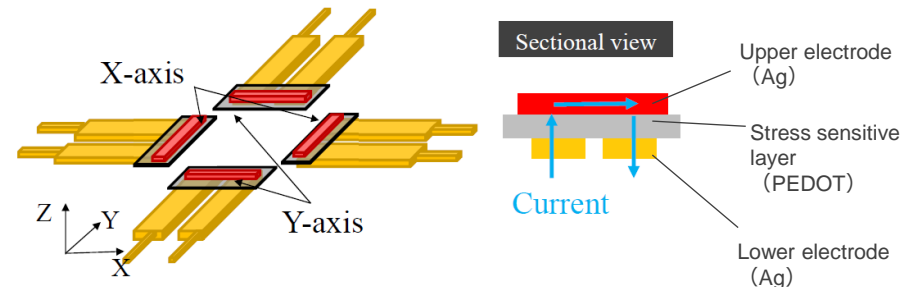


Related patents (3/4)

Sensors developed in the present invention

Structure and principle of the present invention

- Fabrication of upper and lower electrodes and sensing layer by printing technology
- Two stacked sensor elements are arranged in pairs



Related Works

[1] [Presentation materials for the 2023 Kita-Tohoku Three University- Measurement and Environment-New Technology Briefing, sponsored by JST \(Japanese only\)](#)

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