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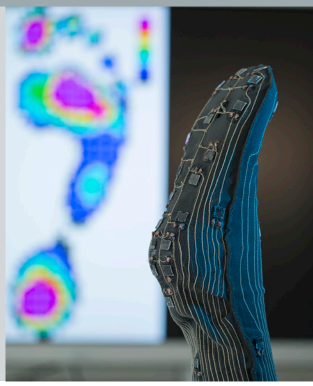

1 - 2 Printed conductive layers on polymer textile, stocking with pressure sensors © Fraunhofer ISC

3 Glove with sensors for motion control © awesome technologies

TEXTILE-INTEGRATED ELASTIC SENSORS AND ACTUATORS

Elastomer sensors can be used to measure deformations, forces and pressures. By adding electrical conductive particles the elastomeres can be used as electrodes or as heating pads. Because of their high elasticity and their soft and flexible characteristic the elastomer elements are especially suitable for integration into woven or knitted fabrics.

Potential for the application of elastomer sensors and actuators exist in health care e.g. to prevent bedsores or to localize the pressure distribution in shoes. They can also support personal training or adress ergonomic questions by measuring the poise in clothes. In collision detection systems, the elastic sensors improve industrial safety, e.g. of human-machine interfaces. Used as electrodes the elastomer sensors can measure body signals, e.g. ECG or EMG. Vice versa the electrodes can function as actuators for TENS, EMS or heating.

Measurement principle

Elastomer strain sensors consist of a very elastic elastomer film, coated on both sides with highly elastic electrodes. The sensor effect stems from the measurement of the electrical capacitance. Under tensile load or deformation, the surface expands while at the same time the thickness of the sensor film decreases, causing an increase in capacitance.

Materials

Silicone rubber is the preferred basic material for the elastomer film because the mechanical and electrical parameters can be adapted in a wide range. Apart from design and geometric dimensions, the hardness of the elastomer determines the sensitivity of the sensor. Silicone rubber offers a broad variation of hardness through chemical crosslinking or additives.

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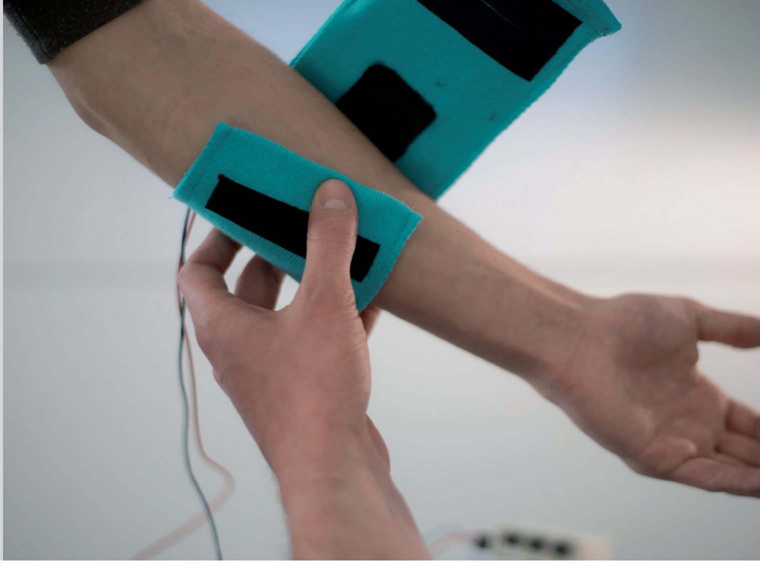

The electrodes on the elastomer film consist of electrically conductive particles which are dispersed in the silicone matrix.

Textile integration

Textile integration can be achieved by bonding or sewing the functional elastomer elements on the textile. The electric signal is passed into a conductive yarn. Elastic and shielded conductive silicon structures can be bonded on the textile fabric.

Ironing or printing is the new and cost-effective way to get the functional and conductive structures on the textile. Ironing temperatures below 80 °C and processing times less than 1 minute allow a fast manufacturing of individual size in small and medium quantities and mass customization.

Textile printing of the elastic conductive and insulating layers reduces the manufacturing costs for mass production.

Applications

Textile integrated elastomer sensors and actuators can be used in the following applications:

- 3-dimensional foot pressure measurement
- Pressure and gesture measurement
- Portable balance
- Input device for game and fitness device controlling
- Load measurement mats
- Collision detection in human-machine-interfaces
- Flexible and elastic switch beneath textile and curved cover
- Pressure sensitive cover in seats
- Detection of posture and mobility
- Electrodes for pulse rate measurement, ECG, EMG, TENS, EMS
- Conductive layers for heating areas

Technical data of functional elastomer elements

- Pressure range 1 - 150 N/cm² (10 – 1500 kPa)
- Pressure resolution 0.1 N/cm²(1 kPa)
- Strain measurement 0 – 100 %
- Strain measurement resolution (1 %)
- Measuring frequency at least 50 Hz
- Electrical conductivity up to 0,6 S/cm (even under 100% strain)
- Temperature operating range from -40 to +180 °C
- Very thin (0,5 mm), elastic (up to 100 % elongation)
- Resistant against water, washing and disinfecting agent

4 *Elastomer foil for ironing on textiles*

5 *Wristband with elastomer electrodes for pulse rate measurement, ECG, EMG, TENS, EMS*

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