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The New Type of Knitted Resistive Fabric and Its Application

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Summary

The developed knitted resistive fabric is related to the production of "smart textiles", integrated in garments for health monitoring. This fabric is produced from conductive resistive, nonconductive regular and nonconductive elastomeric yarns. Elastomeric yarn is the base yarn and is knitted in the whole fabric, but isolating and resistive yarns (functional yarns) are knitted separately from each other, but together with the base yarn in a specific sequence. The proposed knitted resistive fabric has high sensitivity to strain deformation and can be used as a sensing element to control deformation of the human body parts, joint motion, respiration, *etc.*

Introduction

Control systems with flexible sensing elements, made of textile fabrics with conductive threads, find wide range of healthcare applications, including health monitoring and rehabilitation [1-3]. Such systems can be embedded directly in garments and are wearable without any discomfort for the user. One of the types of such sensing elements includes sensors, knitted with conductive yarns [4-5]. Ohmic resistivity of such sensors depends on the deformation of the knitted sensing element. One of weak points of the known knitted sensors is their comparatively low sensitivity. The present paper demonstrates knitted sensing elements that have increased sensitivity that widen the area of possible applications.

Knitting technology and the properties of the knitted structure

The proposed sensing element (knitted resistive fabric) is knitted from conductive resistive and nonconductive isolating yarns together with elastomeric nonconductive thread. Elastomeric thread is the base, but isolating and resistive yarns are functional yarns. Fabric is knitted using plain stitch where courses are formed alternately form isolating and resistive. Due to compressive effect, caused by base elastomeric thread, neighboring courses, formed by conductive yarn, contact each other even in the unloaded sensing element. Such unloaded sensing element has initial resistance R_e which can be defined by Holme's contact theory [6]. Application of strain load in weft direction causes gradual decrease of contact pressure between neighboring threads and, due to this, partial or complete interruption of electrical contact between conductive courses. Such behavior of the knitted structure leads to gradual increase of equivalent resistance R_e. For some cases, resistance of the stretched fabric tends to infinity.

Experiments demonstrated comparatively high sensitivity of the fabric resistivity to strain deformation (Fig.1). The sensitivity depends on the properties of resistive yarn, width of conductive courses, thickness of isolating yarn. By variation of these parameters, one may control the properties of the sensing element. Unfortunately, notable hysteresis has to be taken into account when developing fabric sensor-based measurement system.

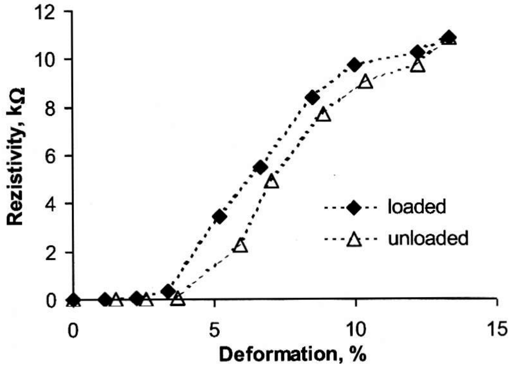

Fig. 1. Typical dependence of the knitted fabric resistivity on the relative deformation (10 cm long and 10 cm wide piece was used)

Conclusion

The proposed fabric demonstrates good sensitivity and may be used for smart textile strain sensors manufacturing.

References

[1] Hoffmann, T.; Eilebrecht, B.; Leonhardt, S. Respiratory Monitoring System on the Basis of Capacitive Textile Force Sensors. IEEE Sens. J. 2011, 11, pages 1112–1119.

[2]Pacelli, M.; Loriga, G.; Paradiso, R. Flat knitted sensors for respiration monitoring. In Proceedings of the IEEE International Symposium on Industrial Electronics (ISIE), Vigo, Spain, 4–7 June 2007.

[3]Mattmann, C.; Amft, O.; Harms, H.; Troster, G.; Clemens, F. Recognizing upper body postures using textile strain sensors. In Proceedings of the 11th IEEE International Symposium on Wearable Computers, Boston, MA, 11–13 October 2007.

[4]Wijesiriwardana, R.; Dias, T.; Mukhopadhyay, S. Resistive fibre-meshed transducers. In Proceedings of the Seventh IEEE International Symposium on Wearable Computers (ISWC'03), New York, NY, USA, 21–23 October 2003.

[5] Atalay, O.; Kennon, W.; Husain, M. Textile-Based Weft Knitted Strain Sensors: Effect of Fabric Parameters on Sensor Properties. Sensors 2013, 13, pages 11114–11127.

[6] Holm, R. Electric Contacts: Theory and Applications, 4th ed.; Springer-Verlag: New York, NY, USA, 1967.