KNITTRONIC

Smart electronic textile substrates based on knitwear as a basis for stretchable electronic circuits

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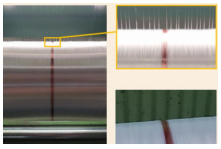
Introduction

The demand and the market for wearables have risen steadily in recent years and this trend will continue. In areas such as automotive, healthcare, mobile and smart devices, wearables have opened up new fields of application. There are stretchable films, which are equipped with electronics, and embroidered as well as woven electronics. Technical requirements and wearer comfort often do not yet go together, because body temperature, fabric sensation and cleaning suitable for everyday use do not easily go hand in hand with cables and electrical voltage. In the Knittronic project, five partners are working on the development of functional textiles in order to meet these extended functional requirements. The aim of the project is to develop a flexible and stretchable textile-based electrical lead.

Partners, Experimental and Results

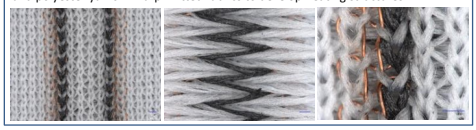
Warp knitted fabrics

Determination and evaluation of the behavior of electrically conductive materials in warping

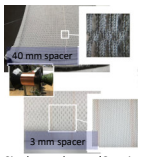


Example of one of the developed knitted structures with maximum stitch offset (left: left side of the fabric; right: right side of the fabric)

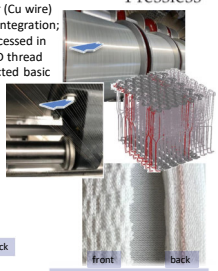
Combination of various conductive materials (bare copper wire and hiTEX® thread) and polyester yarns in warp knitted fabrics to develop heating structures



Warp knitted spacer fabrics

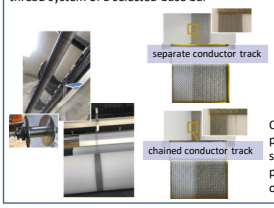


Single conductor (Cu wire) with mutual 3D integration; actively fed, processed in parallel to the 3D thread system of a selected basic bar



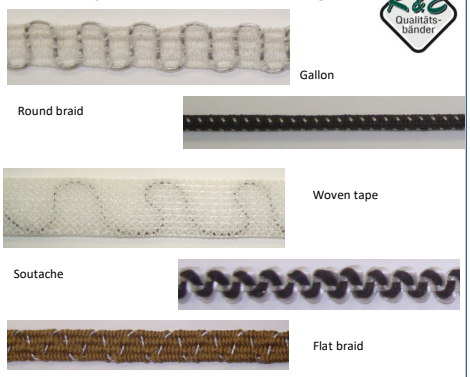
Uniform product appearance with targeted different wire coverage

Single conductor (Cu wire) in surface; passive from spool, parallel to the warp thread system of a selected base bar



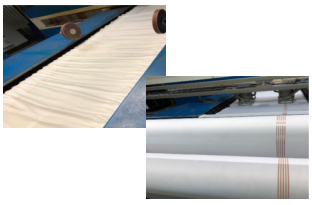
Conductor group (Cu strand; tin-plated) in surface; passive from separate partial warp beam, parallel to the warp thread system of a selected basic bar)

Tapes by different technologies

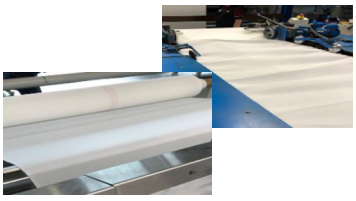


Finishing of the structures

Fixing the warp knitted fabrics



Fixing the warp knitted spacer fabrics

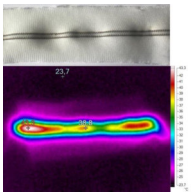


Finishing of tapes

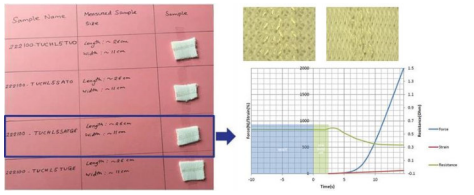
Research into the finishing of textiles in which conductive thread materials are integrated represents a major challenge with regard to the textile-physical properties of the textiles to be developed, since the finishing parameters depend on them to a large extent and must be adapted in this respect.
Various possible functionalizations of the textile fabrics are worked out, such as antibacterial finishing, water and oil repellency, fluorine-free hydrophobic finishing, antistatic finishing and softening or stiffening.

Characterization of electrical behavior

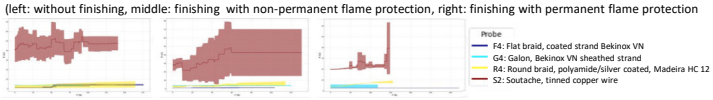
Test of Heating function of a flat knitted fabric with Cu wire and HiTEX yarn in combination



Spacer fabrics - effect of binding and conductor track width



Influence of finishing on stretch and resistance
(left: without finishing, middle: finishing with non-permanent flame protection, right: finishing with permanent flame protection

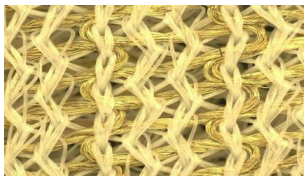


Applications and Outlook

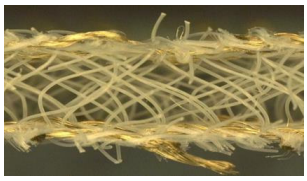
A reliable, smart electronic textile based on warp knitting, which is stretchable or elastic and does not change its electrical resistance under load, enables use in smart electronic textiles for sensor or heating applications without expensive and complex electronics boxes.

Sensor Textiles

- two fully conductive cover surfaces, pole area non-conductive → when the spacer fabric structure is subjected to pressure, the conductive cover surfaces touch each other and an electrical contact is created → **textile switch**
- alternatively, the structure can also be used as a moisture sensor → **detection of penetrating liquids**



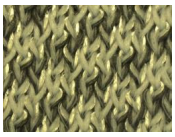
Weft made from Shieldex yarns

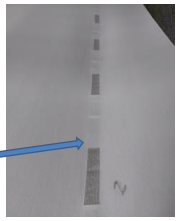


Non-conductive pile thread area made of polyester monofilament

Heating Textiles

- design of a uniformly conductive surface by using high-resistance yarns (e.g. hiTEX®) on a cover surface → adjustment of the surface resistance by varying the thread feed
- non-conductive pile thread area has a heat-insulating effect
- supply lines incorporated directly into the knitted structure → Use of highly conductive uninsulated yarns such as silver-plated copper strands or ELITEX®
- using ELS control, the contacting area can be guided to the back





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