universität innsbruck

Stretchable Conductive Textiles Based on Nanostructured Templates

FTI Produktion der Zukunft; FFG-865927

Stakeholderdialog „Vom Rohstoff zum Werkstoff“
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The University of Innsbruck was founded in 1669 and is one of Austria‘s oldest universities. Today, with over 28.000 students and 4.500 staff, it is western Austria‘s largest institution of higher education and research. **For further information visit: www.uibk.ac.at.**

Project facts

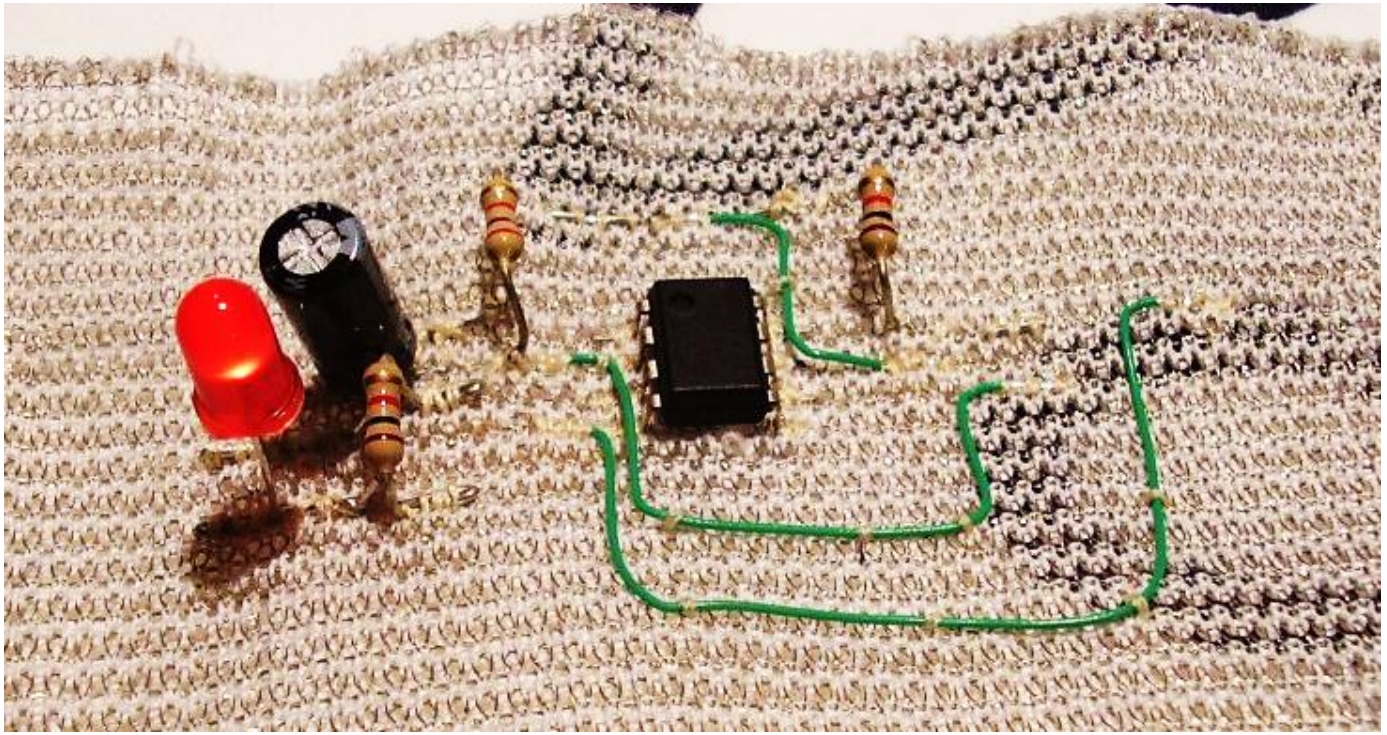
Duration: 02.2018 - 01.2021

Partners:

- **Universität Innsbruck, Research Institute of Textile Chemistry and Textile Physics:** textile chemistry and physics, fibre science and polymer science
- **V-trion textile research GmbH:** textile finishing, surface modification and charaterisation
- **Textilveredlung Grabher GmbH:** finishing of textile substrates and plasma technology
- **Texible GmbH:** development and manufacturing of smart textiles, electrical devices by technical embroidery
- **J. Zimmer Maschinenbau GmbH:** digital coating / printing, own printing technologies

Challenges

- Loss of conductivity by stretching leads to unreliable usage
- High thickness of the conductive layer leads to more “rigid” textiles rather than being flexible.



Project summary

Target

- Development of a reliable technology to produce stretchable conductive textiles retaining conductivity by typical usage conditions
- Base technology for further integration of electronics into textiles

Technical conception

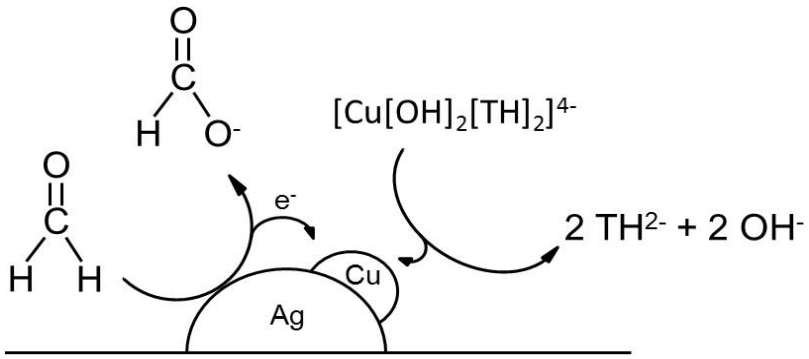
- Permanent electroless metal coating of the fibre surface based on a nanosized metal seed layer template
- Through formation of conductive coating layers of metal in the dimension of some hundreds of nanometer, conductive properties will be provided on the surface of insulating polymer fibres.
- Under tension the mobility of the fibres in the textile structure will allow continuous contact thus elastic structures with conductive properties will be delivered.

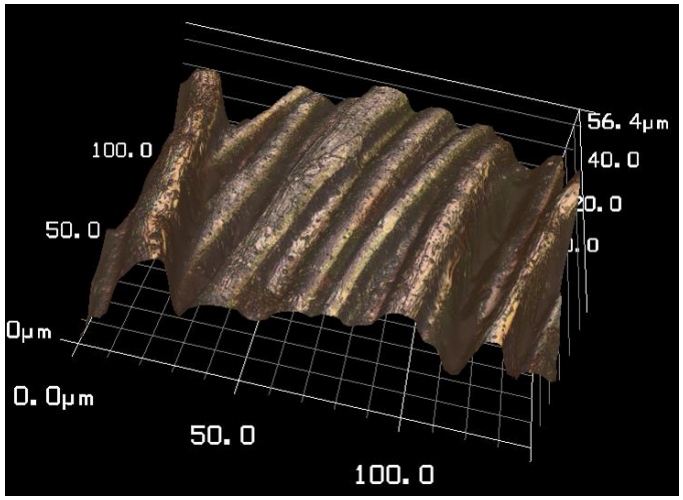
Basic mechanism

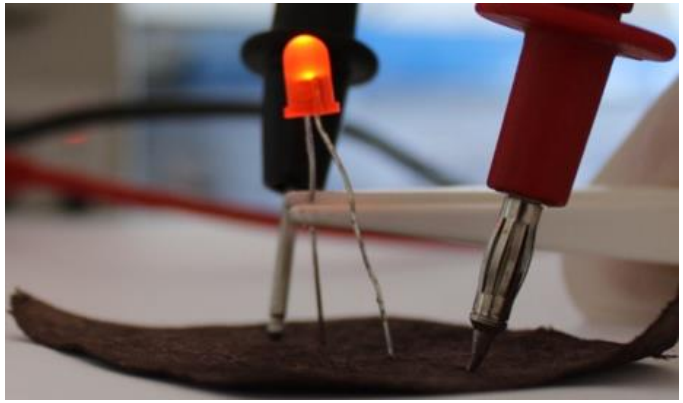
- Seed formation

$$Sn^{2+} + 2\,Ag^{+} \rightarrow Sn^{4+} + 2\,Ag^{0}$$

- Metal deposition on nanosized seed template







- Sufficient conductivity by stretching
- Very high ratio between total fibre and conductive layer contents
- Nano-sized conductive layer thickness

WP2

Surface activation
(UIBK, VTRION, TEGRA)
- Plasma surface activation
- Chemical surface functionalisation

WP3

Nanostructures seed template
(UIBK, ZIMM)
- Nano seed particle formation and distribution
- Bounding behaviour of nanosized seed particles on fibres / fabrics
- Printing techniques

WP4

Electroless deposition of conductive layer
(UIBK, TEGRA, TEXI)
- Conductive layer formation
- Effect of seed template
- Effect of surface functionalisation
- Bounding behaviour of conductive layer on fibres / fabrics

WP5

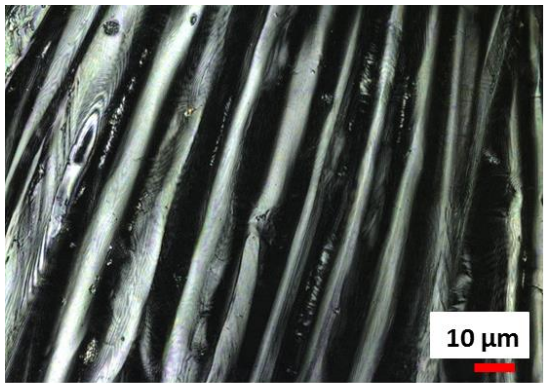
Surface passivation
(UIBK, VTRION, TEGRA)
- Polymerisation
- Coating, printing
- Bounding and abrasion behaviour

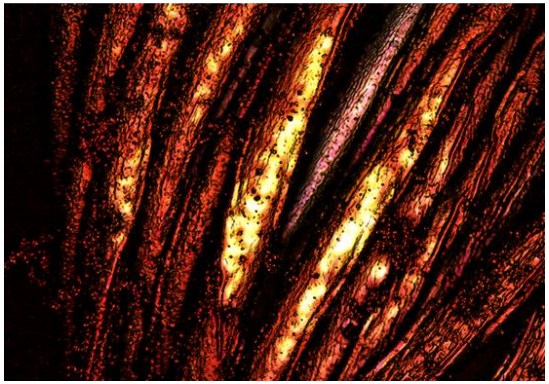
WP6

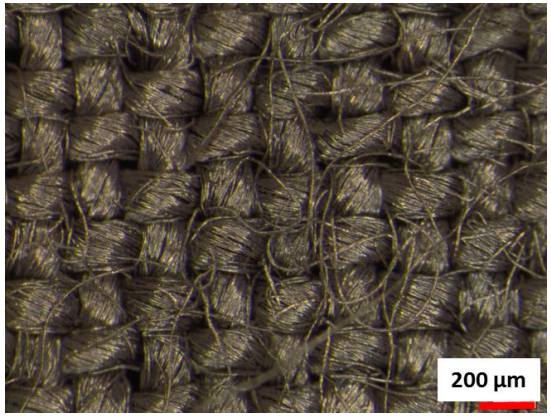
Characterisation and application testing
(UIBK, VTRION, TEGRA, TEXI)
- Chemical, electrical mechanical, physiological
- Definition of use cases and application testing
- Demonstrators and testting
- Marketing and implementation concepts

WP1

Project organisation and management, project reporting and controlling (UIBK)







Targeted applications

- Functional textiles in healthcare, sports, safety, energy harvesting and storage etc.
- Integration of miniaturised sensors in a textile structure, e.g. for humidity, temperature, pressure, gas sensors etc.
- Flexible large area textile sensor networks
- Printed flexible electronics
- Flexible circuits

Base technology for further integration of electronics into textiles

Thank you very much for your attention

bmvit

Federal Ministry
for Transport,
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