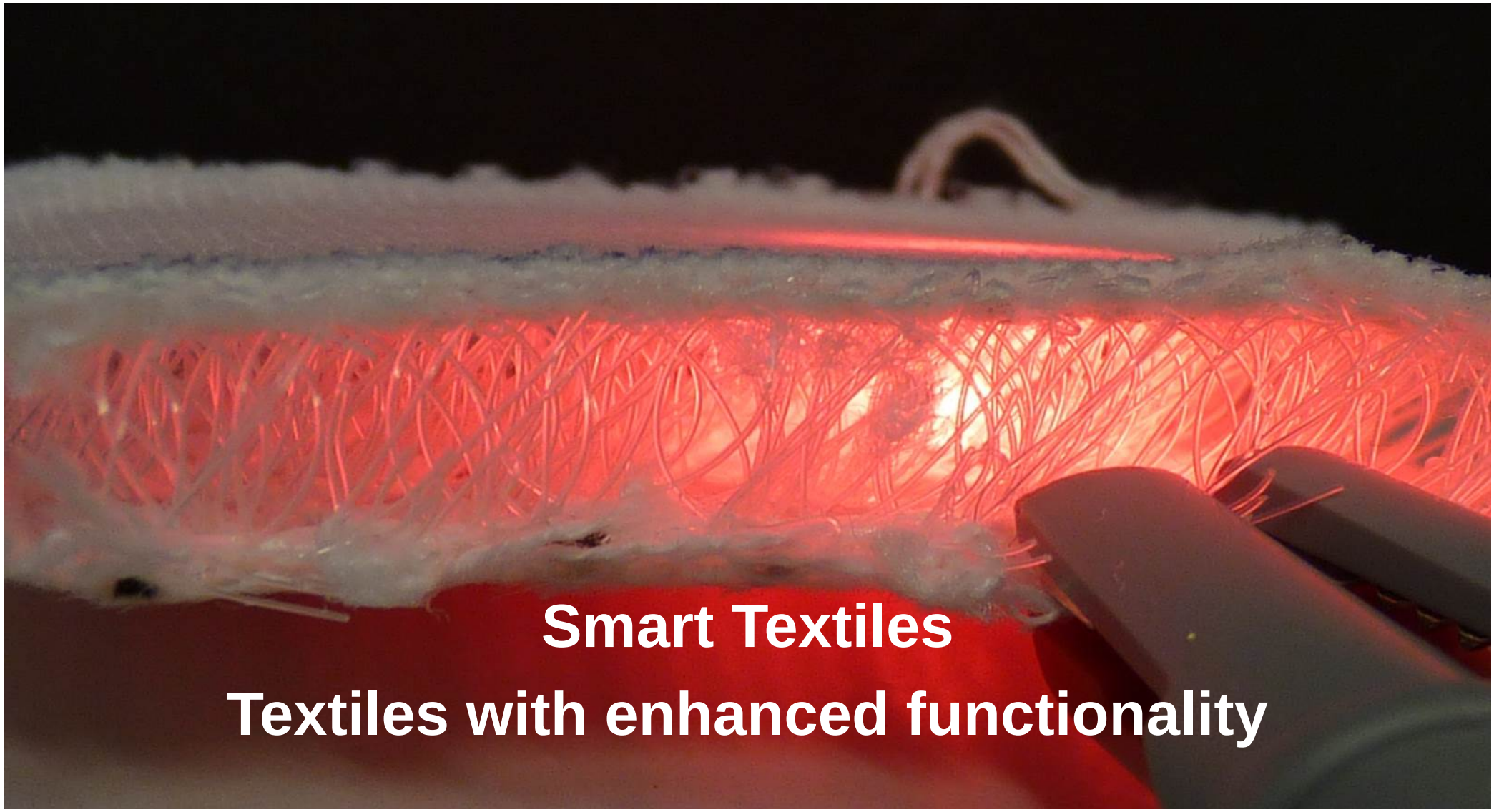


Smart Textiles

Textiles with enhanced functionality

ITA

RWTH AACHEN UNIVERSITY

3T

Smart Textiles at the ITA

What are Smart Textiles?

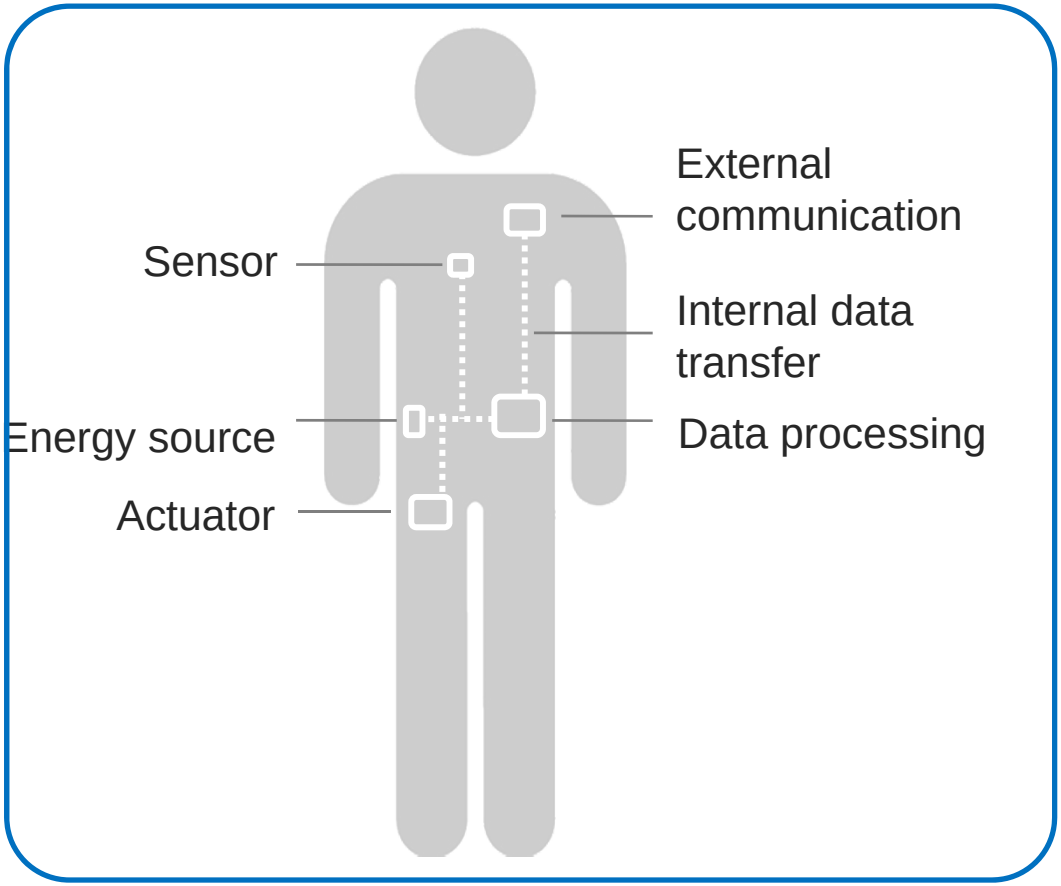
Our activities in the Smart Textile sector?

What we have to offer

Smart Textiles respond to the surroundings (DIN/CEN 16298)

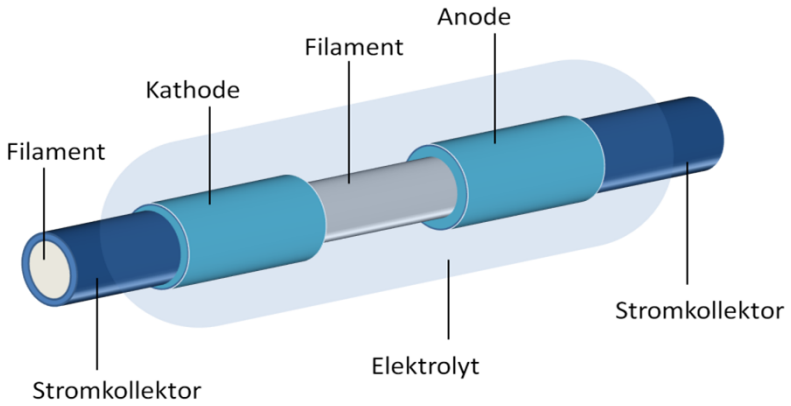
Smart Textiles systems consists of 6 component groups

1. Sensors
2. Actuators
3. External communication
4. Internal data transfer
5. Data processing
6. Energy source

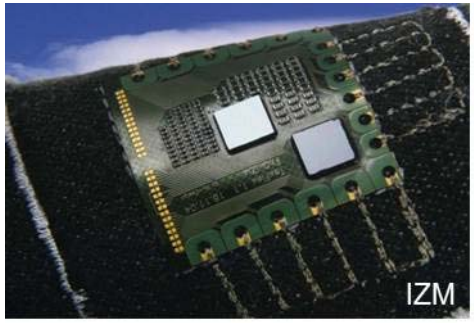


Developement of Smart Textiles over time

ScotteVest



Before	Today	Tomorrow
Textile and Part Textile-adapted	Textile with Part Textile-integrated	Textile is Part Textile-based



Smart Textiles at the ITA

What are Smart Textiles?

Whar are our activities in the Smart Textile sector?

- Technology
- Applications
- Characterization
- Projects

What we have to offer

What are our technologies for Smart Textiles?

Fiber and thread production	Extrusion, spinning, plying, coating
Textile production	Knitting, weaving, braiding, embroidering, sewing
Construction and connection technology	Soldering, adhesive bonding, crimping

Electrically conducting particles are spun into fibres by means of melt spinning

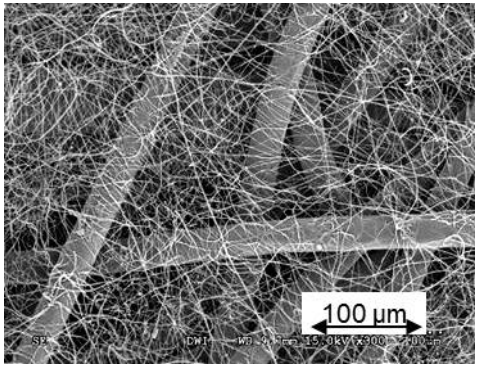
Melt spinning with industrial and laboratory system:

- Filament production
- Biocomponent fibre production
- Piston spinning plant

Melt spinning

Biocomponent spinning plant

Electro spinning under laboratory conditions



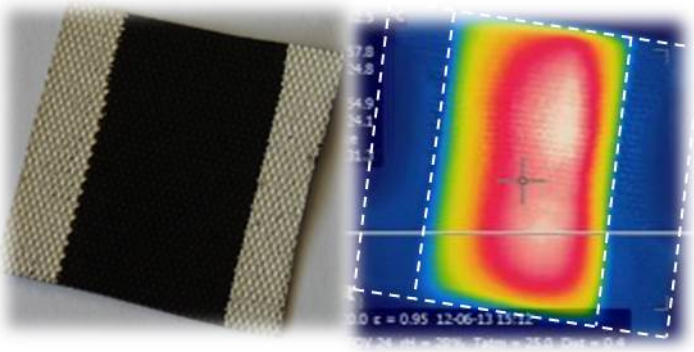
Electro spun nanofibres

Yarn is coated with conductive material

Functionalization of textile surfaces and Yarn

- Electrical and thermal conductivity (metals, CNTs)
- Electrical and thermal isolation
- Corrosion resistance (washability)
- Heating coatings
- Piezoresistive textiles

Machine for coating



Printed heating coating, IR-picture

Electrically conductive textiles are produced by means of conventional textile processes

Knitwear (Knitted fabrics, warp-knitted fabrics)

- Adaptable elasticity
- Dislocation-resistant lattice structure

Woven Narrow Fabrics (Tapes)

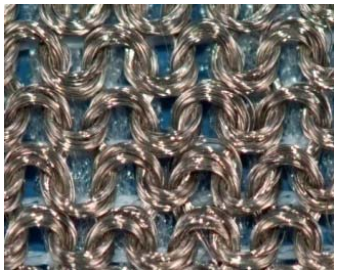
- High stiffness op the product
- Perpendicular orientation of conducting fibres

3D textiles (spacer fabric, 3D-fabrics)

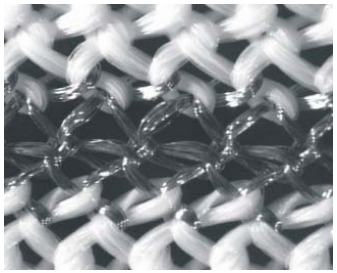
- Functional multilayer
- Adaptable separation distance and compressive strength pile yarn)

Braids

- Sheath-core-structure
- Braided ropes with conductor tracks and electromagnetic shielding

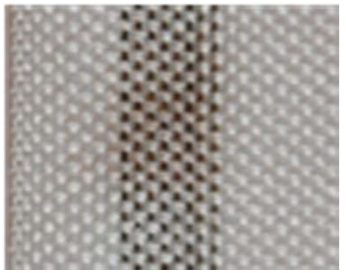


knitted fabric



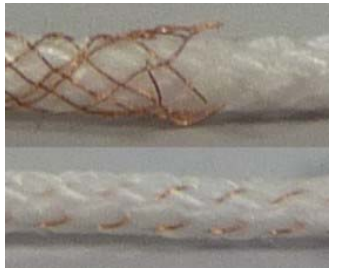
warp-knitted fabrics

broad woven fabric



narrow woven fabric

3D Spacer fabric



braids

Versatile conductive yarn structures are realized by embroidering technology

Tailored Fibre Placement (TFP) embroidering machine

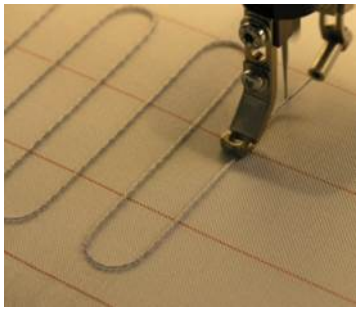
- Deployment of fibre material with upper and lower thread on a base textile
- Application and combination of different fibre materials: Carbon, glass, basalt, aramid, natural, thermoplastic und ceramic fibres, as well as metallized yarns

Kettle and moss embroidery machine

- Embroidery head for kettle and moss embroidery
- Automatic yarn change for 6 different yarns

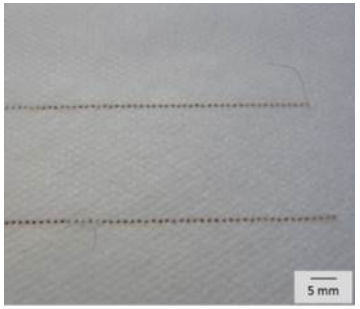
Multi-Head embroidering machine (11 needles)

- Functionalization of textiles by application of electrically conducting fibres and yarns
- Locale enhancement and material combination
- Embroidering of textile electrodes



TFP embroidered stainless steel fibre for heating textiles

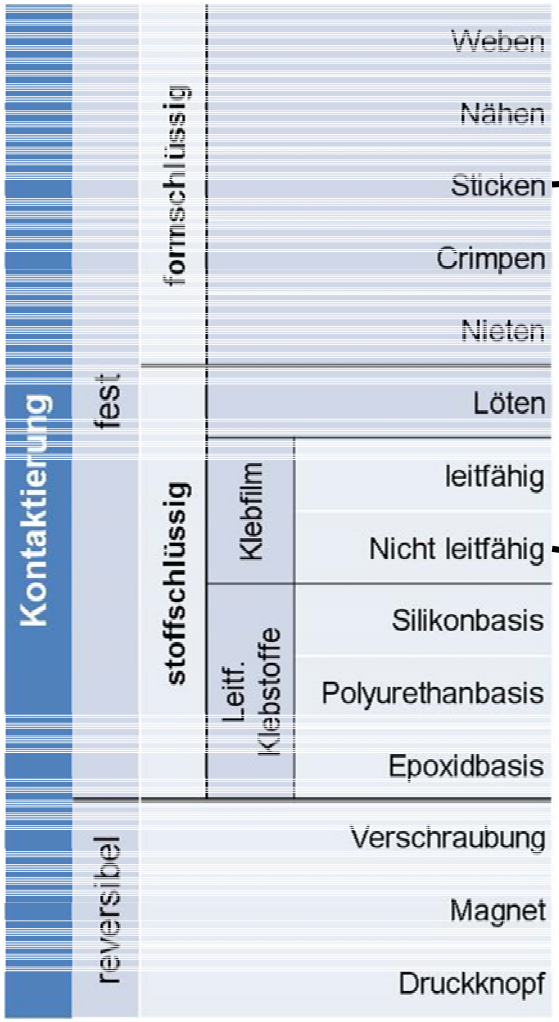
Embroidering machine with 3D-TFP fixation device and K-head for kettle and moss embroidering

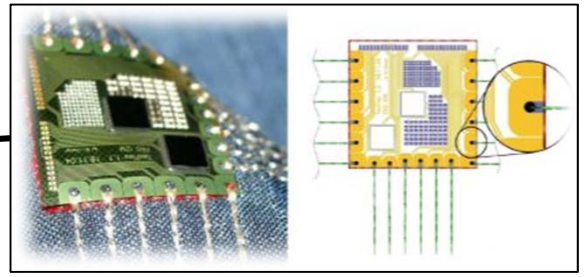


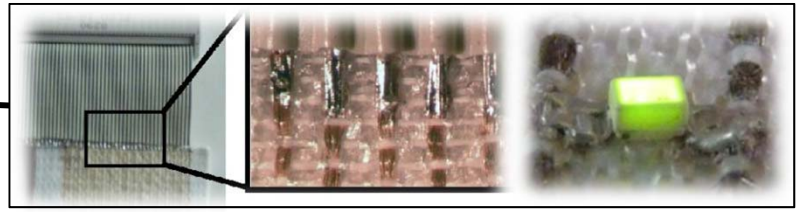
Embroidered platinum fibre for electro simulation

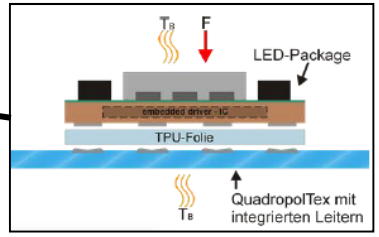
Textile electrode obtained by moos embroidery

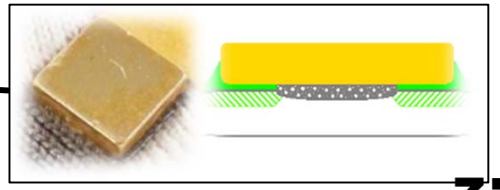
Electrical contacting of textile and electronics must be flexible and robust











Quelle: ITA, IZM, Lumoled, ITV

Our applications for Smart Textiles

Health monitoring –
Textile electrodes improve skin compatibility

Measurement of the skin resistance

- Measurement of the body fluid level
- Recording of vital functions

Temperature measurement

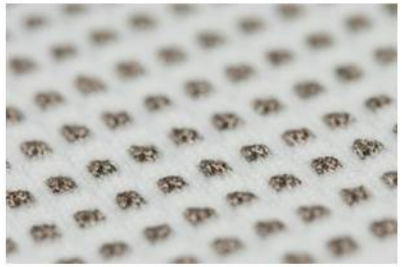
- Textile thermocouples made of stainless steel yarn and constantan filaments

Pressure point detection

- Realized by textile switch matrix

Target group

- Elder people, athletes and patients with increased risk



State monitoring of technical textiles– Structural Health Monitoring (SHM)

Sensor for determination of load on rope

- Detection of acting loads and overload by change of electrical resistance

Sensor for wear detection

- Objective assessment and prediction of residual lifetime

Applications

- Safety ropes , mooring lines, parachute lines, elevator ropes

Sensor filament in a braided rope

Contacting of the rope

Textile illumination of interiors and clothing

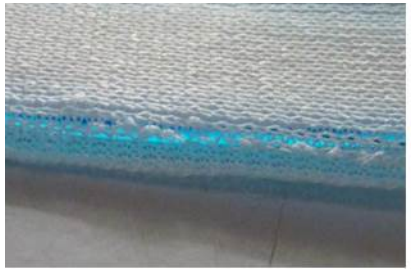
Use of different lighting components

- Active lighting (organic and inorganic LEDs, luminescent yarn)
- Passive lighting (optical conductor, fluorescent and phosphorescent material)

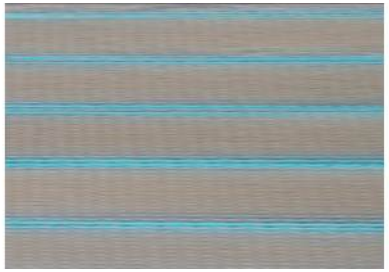
Extensive and on the spot illumination

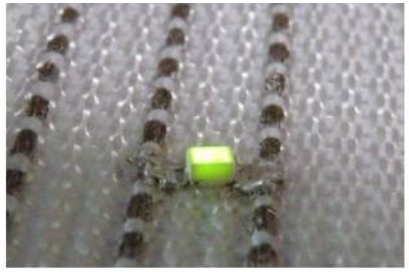
Construction of composite structures for lighting textiles

Integration of sensors for the control of the lighting

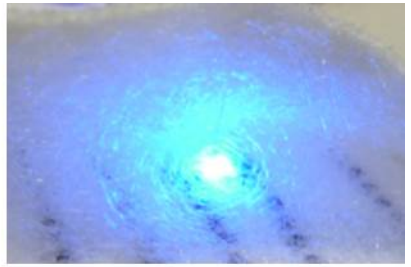


Optical yarn in spacer fabric





LED on textile



Luminous effect realized by hybrid structure

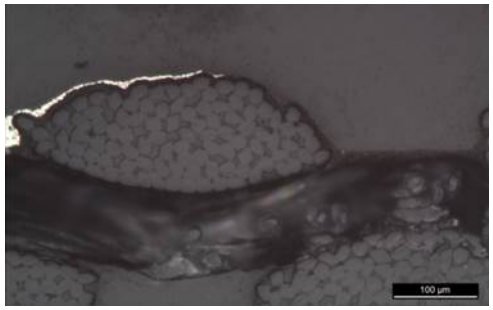
Smart Textiles for heating applications

Heating materials

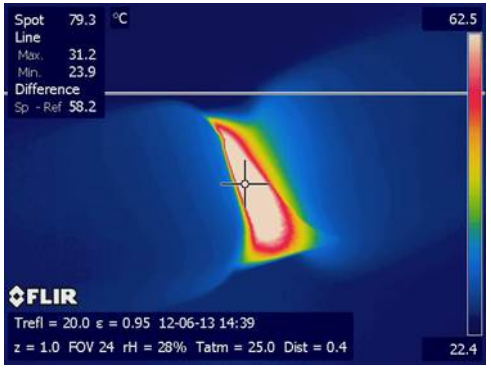
- Carbon, CNT-Yarn
- Stainless steel yarn
- Silver coated polyamide yarn
- Copper strands
- PTC material
- Isolated/ non isolated

Thermo sensors

- Usage of yarn with different thermoelectric voltage Silver – Constantan, stainless steel - Constantan



PTC print on fabric



Thermo image of PTC-print

Production process

- Tailored Fiber Placement
- Knitwear
- Weaving
- Printing processes

Test methods

- Thermo images
- Temperature sensors
- Temperature, resistance and stress condition under tensile load

Interface between textile and user

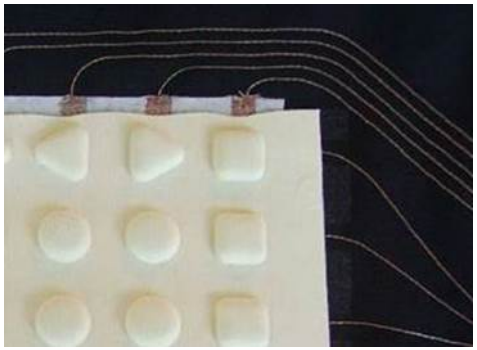
Concepts of interaction with textile

- Textile switch matrix
- Haptic-intuitive input signal via creases
- Proximity and touch sensor

Development of textile bus systems

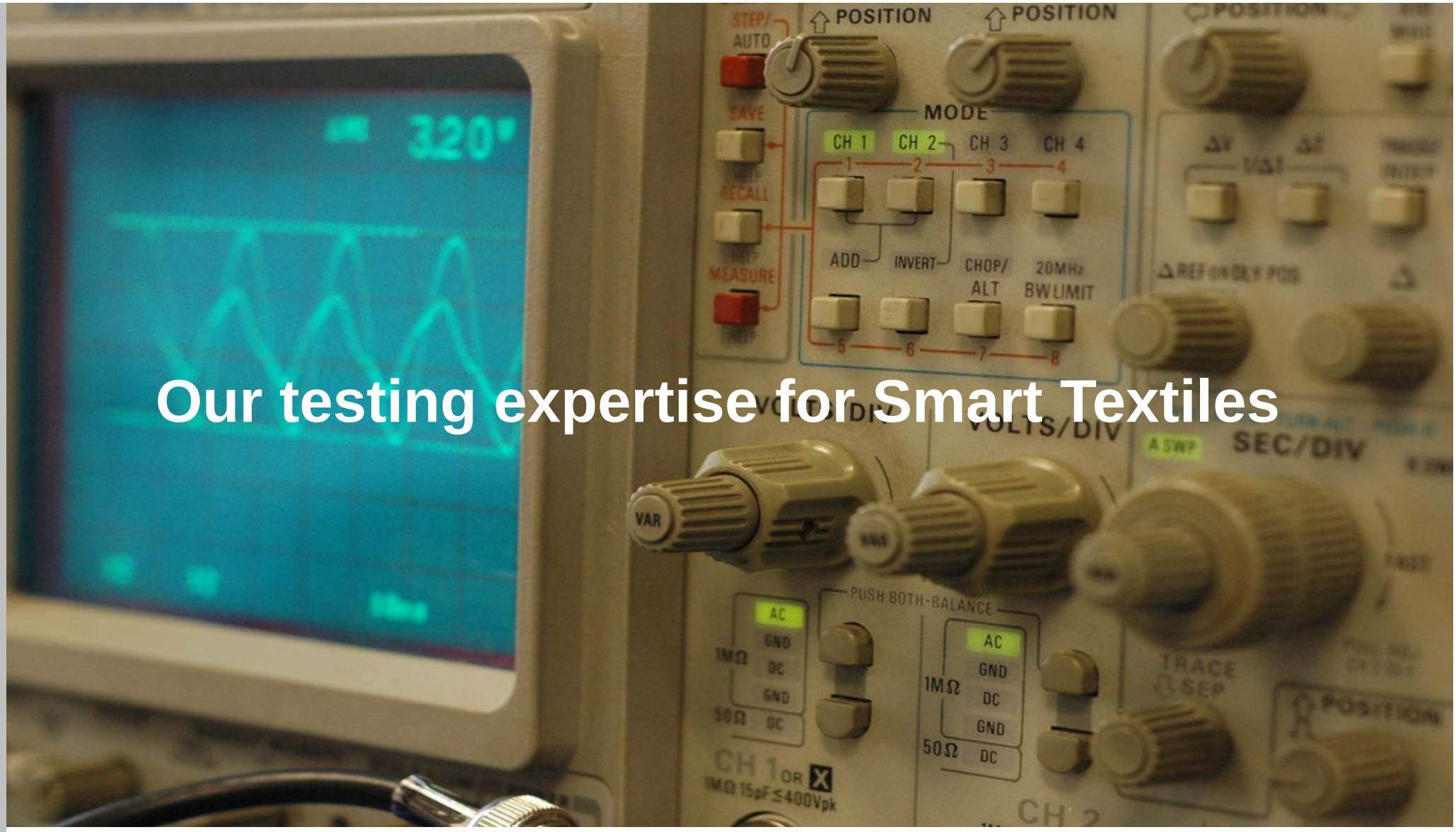
- Knitting, webbing and weaving of data links

Textile proximity sensor



Textile switch matrix and connected conductor tracks

Input signal via creases



Our testing expertise for Smart Textiles

Testing varies from mechanical, electrical and electro-mechanical methods

Standard test methods e.g.

- Testing of tenacity and elongation
- Washing resistance (standardized washing machine)
- Hardware signal preprocessing
  (analog, digital)
- Measured value processing

Development of custom testing methods

- Test bed for ropes with integrated monitoring system
- Electrical resistance of textile electrodes
- Durability testing of a textile push-button

Smart Rope testing device


PROJEKT

ALL4REST – Improvement of the quality of sleep by …

Usage of biomaterials

Microencapsulation

- Stents
- Climate regulation with PCM

Warmth regulation

- Textile heating system
- Textile cooling system

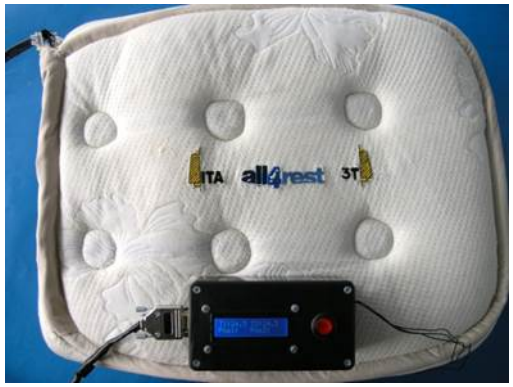
Motion and state monitoring(ITA)

- Textile motion sensor
- Textile temperature sensor

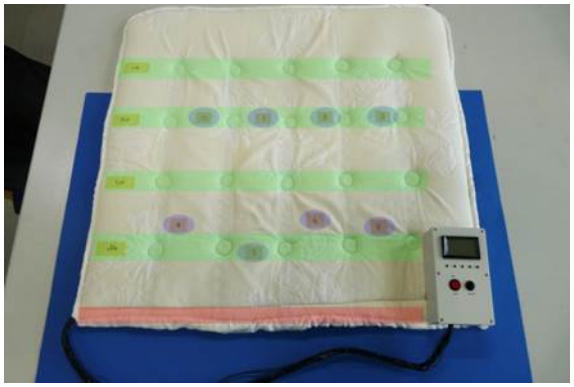
Supported by: EU, 7. Program

Run time: 01.01.2011 - 31.12.2013

all4rest
integrated solutions for
improve the quality of rest



Prototype of mattress with temperature and movement sensor



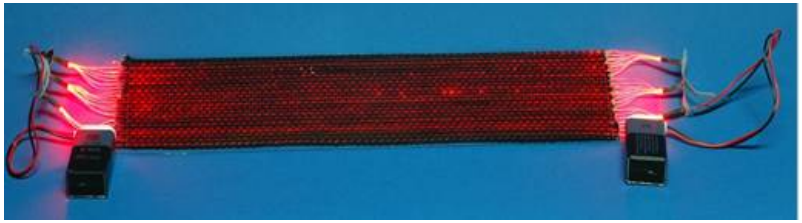
Prototype of mattress cover with temperature and movement sensor

Project „Technical Textiles for Health and Mobility

- Development of textile controls

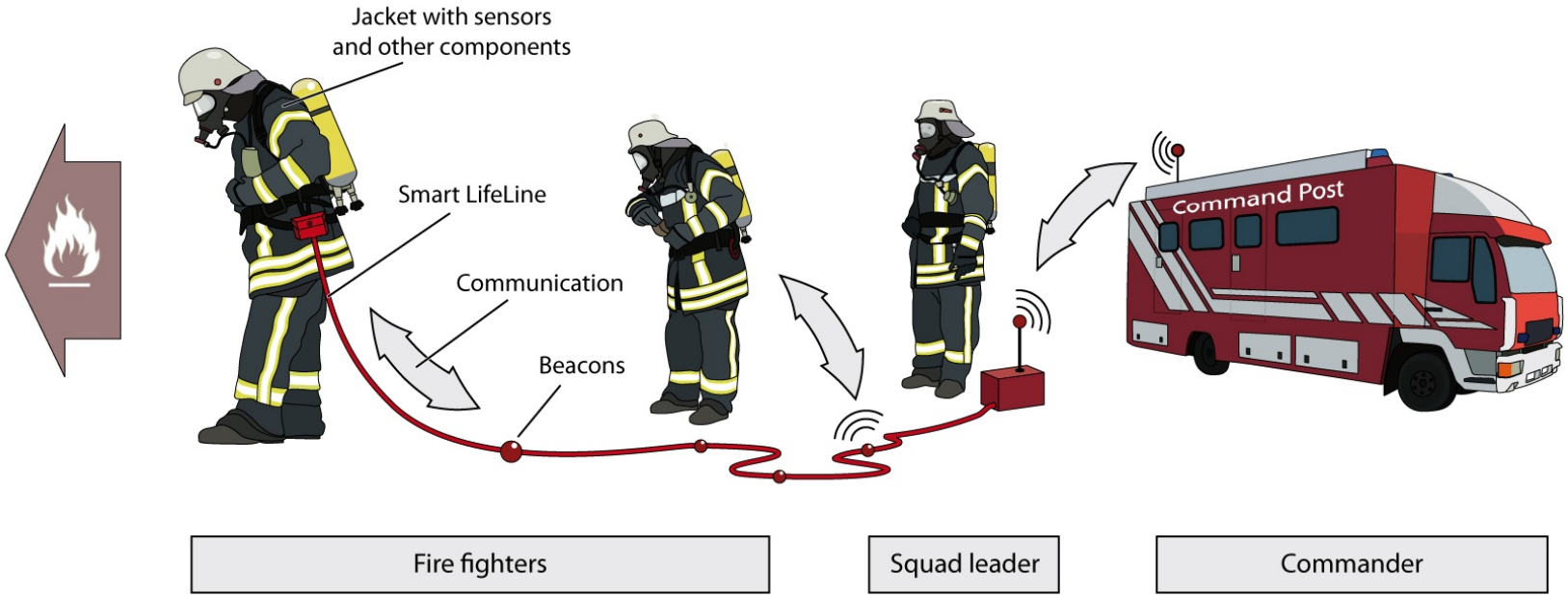
  Textile switch in vehicle door for window opener
- Textile integrated illumination
  - Active: multi layered textile with integrated LEDs
  - Passive: optical fibers in composite material
- Concept for driver monitoring
- Supported by: Ziel2.NRW
- Run time: 01.01.2010 – 30.09.2012

Roof interior with textile integrated LEDs



composite material with integrated optical fibres

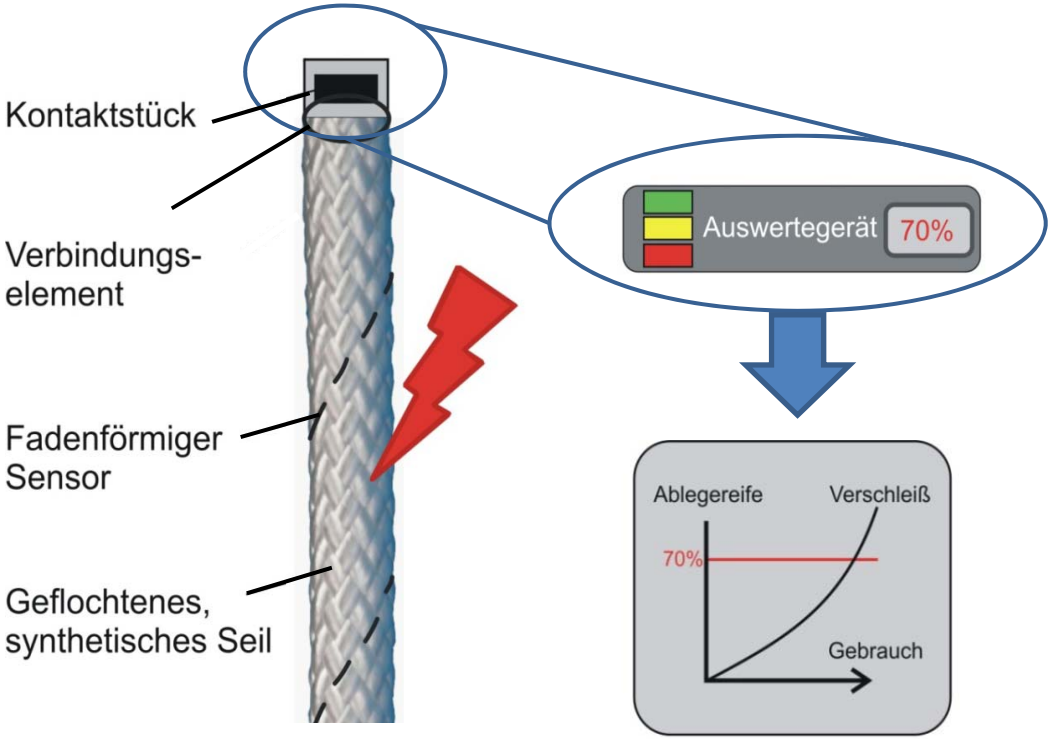
Project „Profitex – safety technology for firefighters



- Development of a tactical command and deployment system
- Project goal: operating efficiency and safety improvement
- Textile integrated components in firefighter‘s jacket (textile bus system)
  - Indoor-navigation, monitoring of the rescue workers ...
- Data transmission (short range: radio; long range: braided security rope with integrated electronic beacons)
- Run time: 01.10.2009 - 30.09.2012

Project „Smart RopEx“ – Ropes indicate when they are worn out

- Development of sensor and analysis procedure for an objective assessment of the residual life time of synthetic ropes in different scenarios:
  - Winch rope
  - Lifting sling
- Creation of a database for removal Criteria in laboratory and practice
- Production and testing of different sensors and connections
- Run time: 01.06.2010 - 31.12.2013



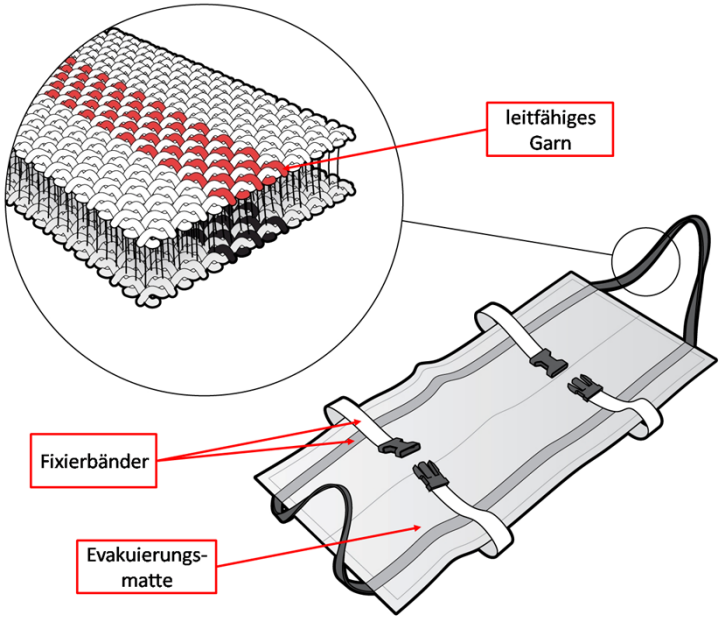
Development and testing facility for innovative textiles in the vehicle interiors: Automotive Interior Center (AIC)

- Centre of competence for automotive interiors in NRW
- Test bed for a systematic determination of the influence of textile components in the interior on the acoustic and thermal perception of comfort
- Assessment of material characteristics for the layout of textiles
  - Textile production chain in laboratory scale
    (AIP: Automotive Interior Prototyping)
  - Representation of the interior textiles in a computer simulation in order to support their development
  - Run time: 13.12.2012 - 30.06.2015

ITA ika INSTITUT FÜR KRAFT-FAHR-ZEUGE ingema Johnson Controls RWTH AACHEN UNIVERSITY Ziel2.NRW Regionale Wettbewerbsfähigkeit und Beschäftigung 3T

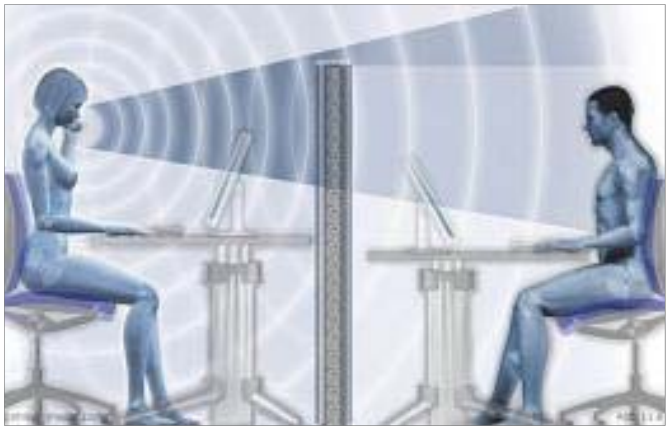
Project „Kostbar“ – State monitoring of extensive technical textiles

- Sensors for automatic position identification
  - Position identification of the patient via functionalized evacuation mats
- Sensor for pressure control
  - Pressure sensor made of 3D-spacer fabric for an anti-decubitus monitoring
  - Electrical analysis
- Run time: 01.09.2012 – 31.08.2014

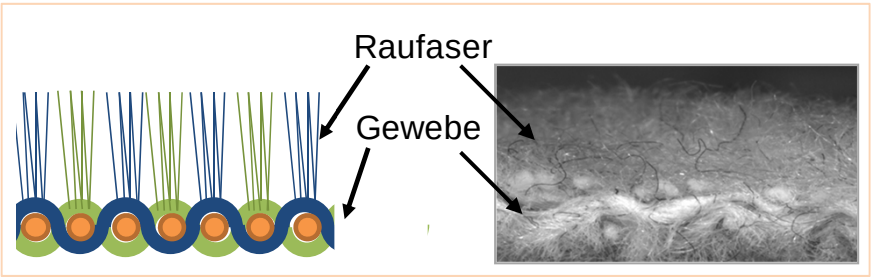


Project „Akustikdecke“ – Innovative sound absorber based on coarse fabric

- Development of a coarse fabric with high sound absorption coefficient
- More sustainable and non-polluting production process
- Meeting the customer requirements regarding
  - Washability
  - Manageability and ease of assembly
- Run time: 01.09.2012 - 31.08.2014



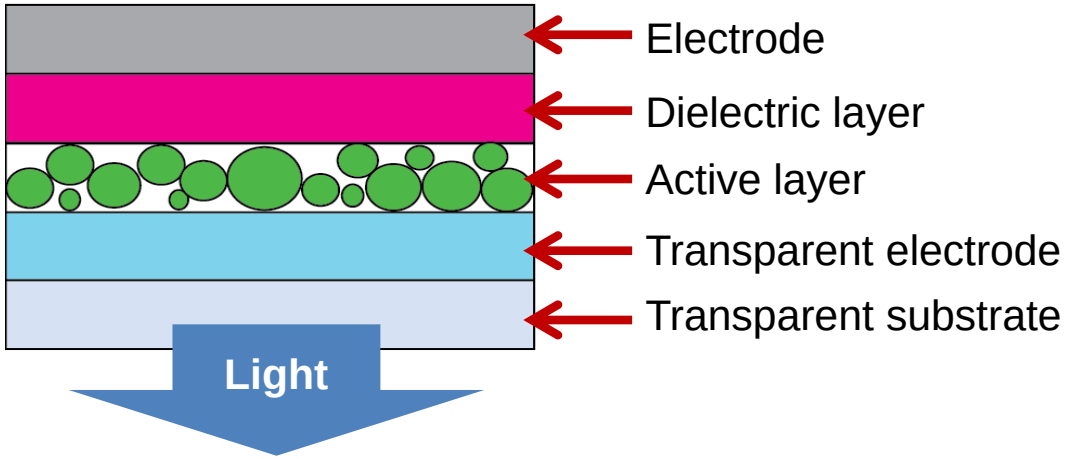
Principle of sound absorption



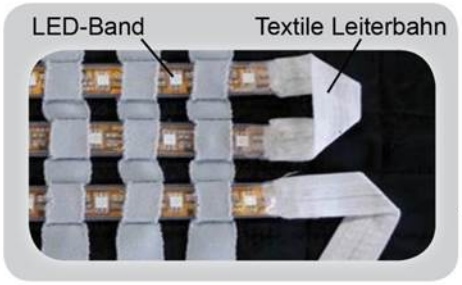
Schematic of fibrous web

Project „POLEOT“ - Printing of Light-Emitting Devices on Textile

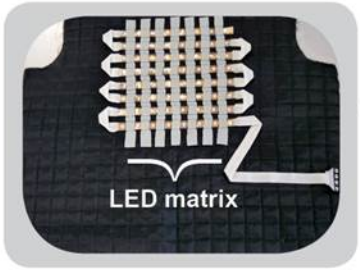
- Development of a printing process which allows printing of light emitting EL- or OLED layers
- Usage of energy efficient lighting technologies for large-scale applications
- Most important aspect is encapsulation:
  - Minimal environmental influences on the active material
  - High flexibility of the textiles
- Run time: 01.05.2013 - 30.04.2015

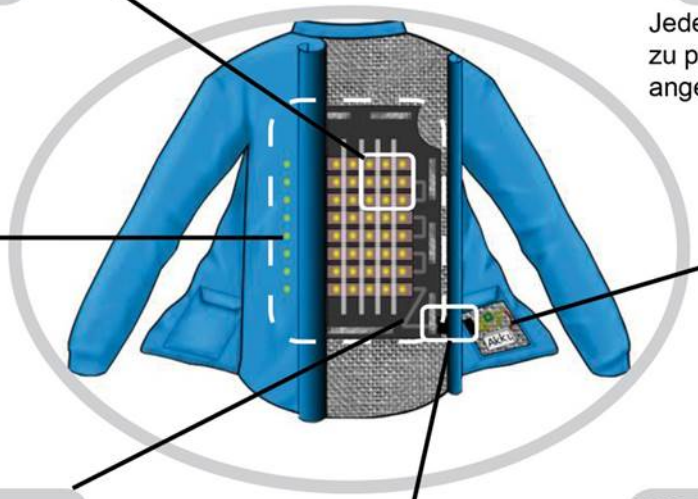


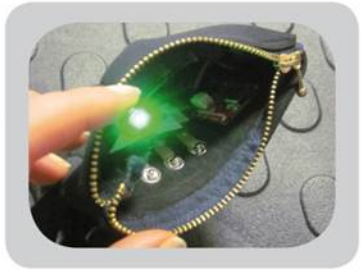
Project „Intelligent illuminated jacket“



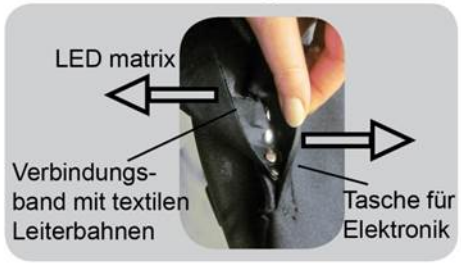
Jedes einzelne LED ist im RGB-Farbmodus zu programmieren. Text und Muster können angezeigt werden.

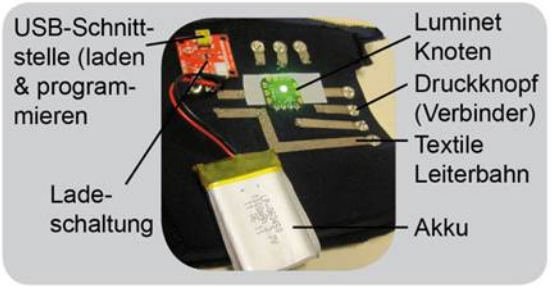




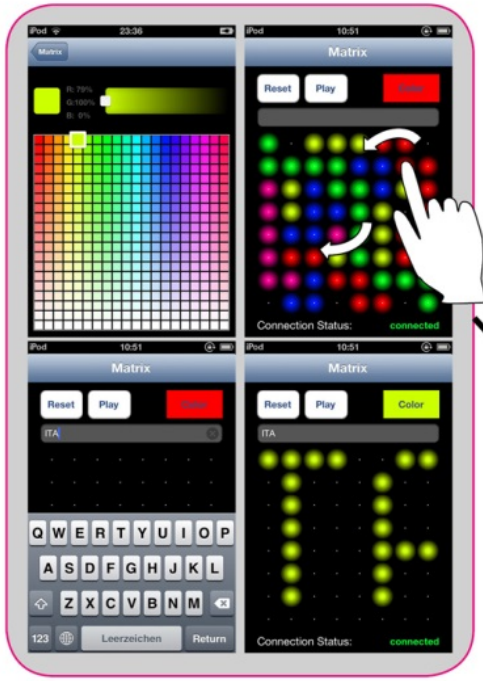


Tasche für Elektronik (wasserfest)

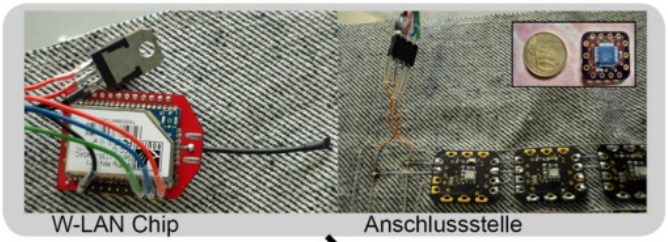




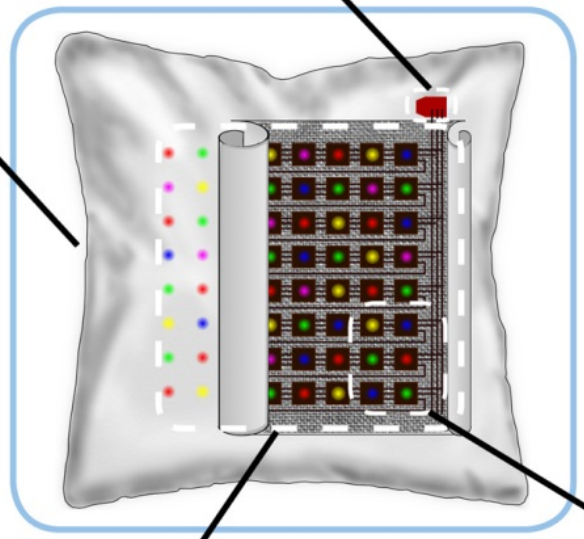
Project „Intelligent illuminated pillow“

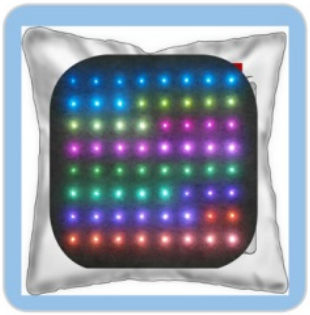


Ipod-App: Texte, Freihandzeichnen, Muster in beliebigen Farben und Kombinationen werden über App live aufs Kissen übertragen.



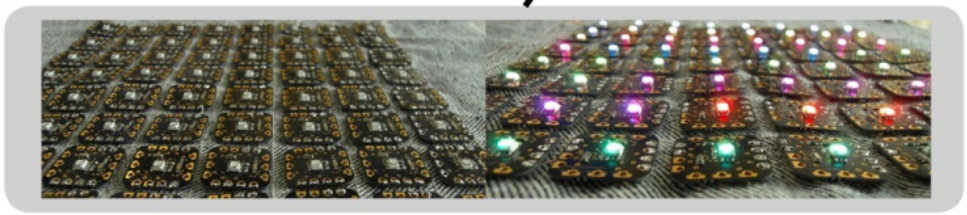
W-LAN Chip Anschlussstelle



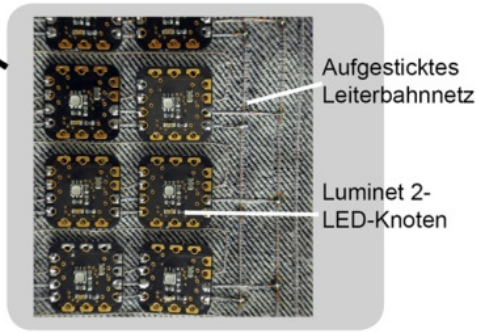


Demo-Kissen mit interaktivem LED-Display

LiPo-Akku mit USB-Anschluss zur Stromversorgung



Kontaktierte LED-Chip-Matrix



Aufgesticktes Leiterbahnnetz

Luminet 2-LED-Knoten

Smart Textiles at the ITA

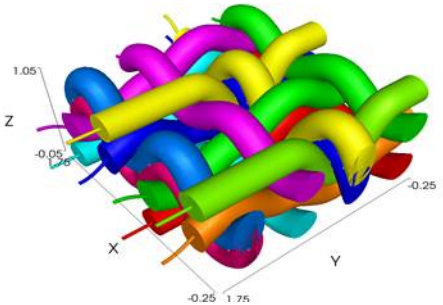
What are Smart Textiles?

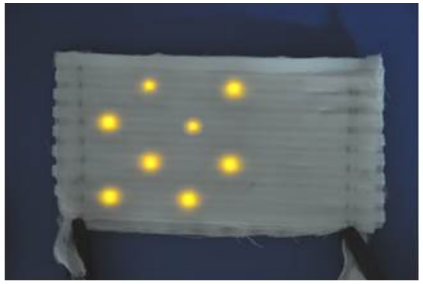
Our activities in the Smart Textile sector?

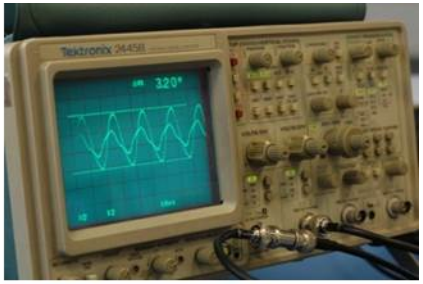
What we have to offer

Our services for partners and industrial clients

Design → Processing → Application → Control







Our services for partners and industrial clients

Conceptual design

Sensor development

Technology

Control

Evaluation and stability testing

Product development

complete systems

Complete production processes

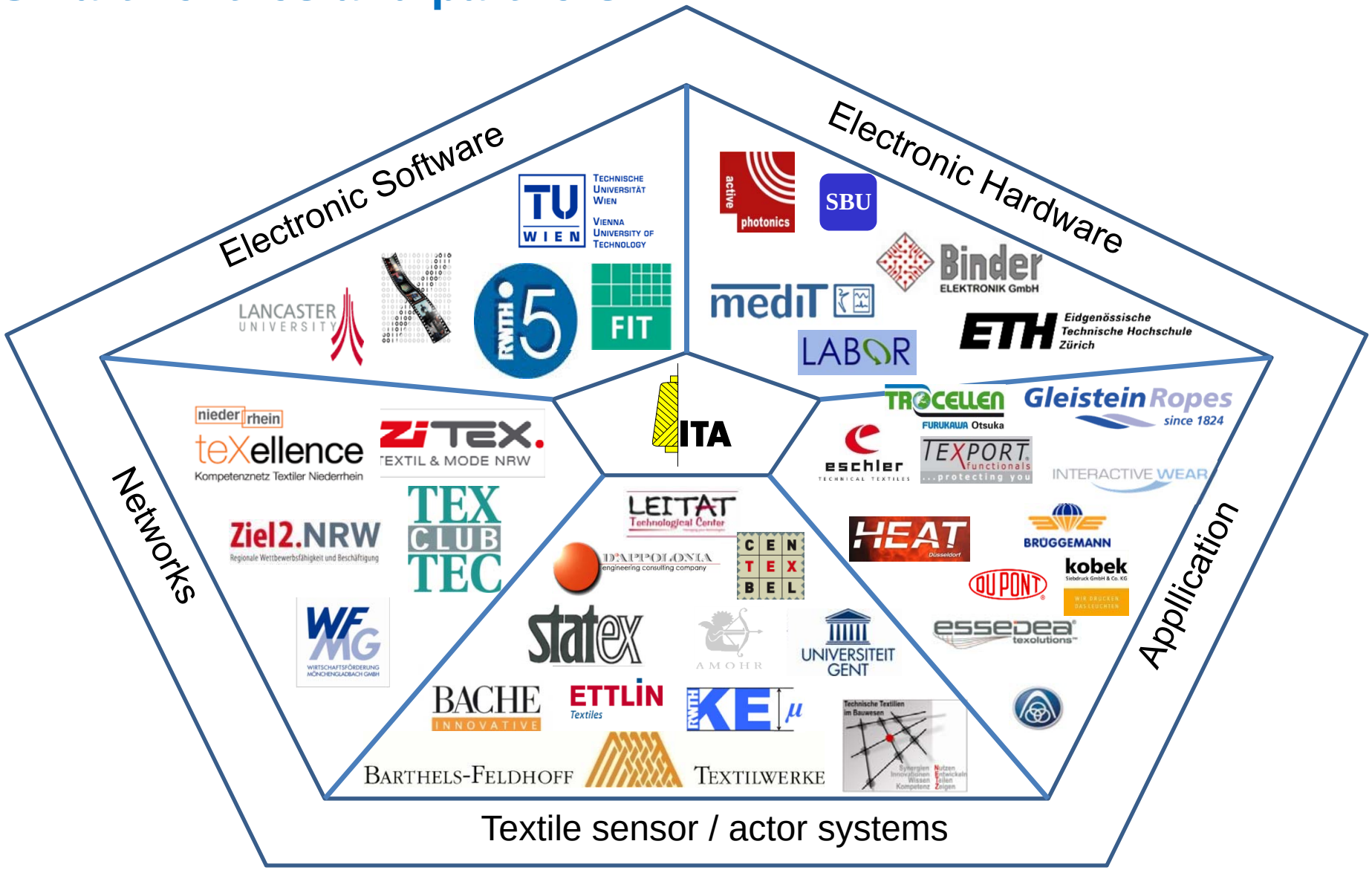
production chains

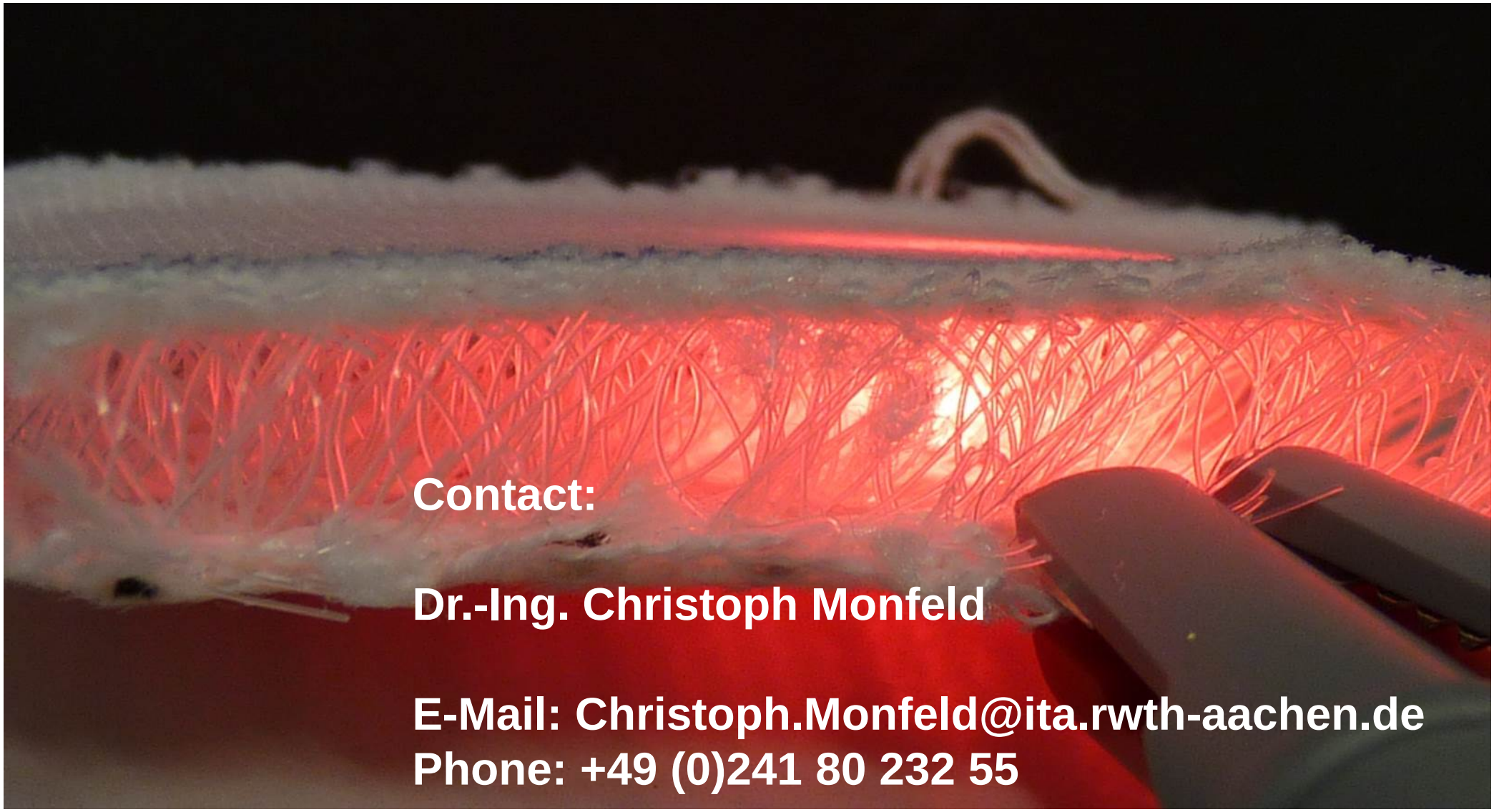
and individual processes

Textile construction- and

connection technology

Smart Textiles and partners





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