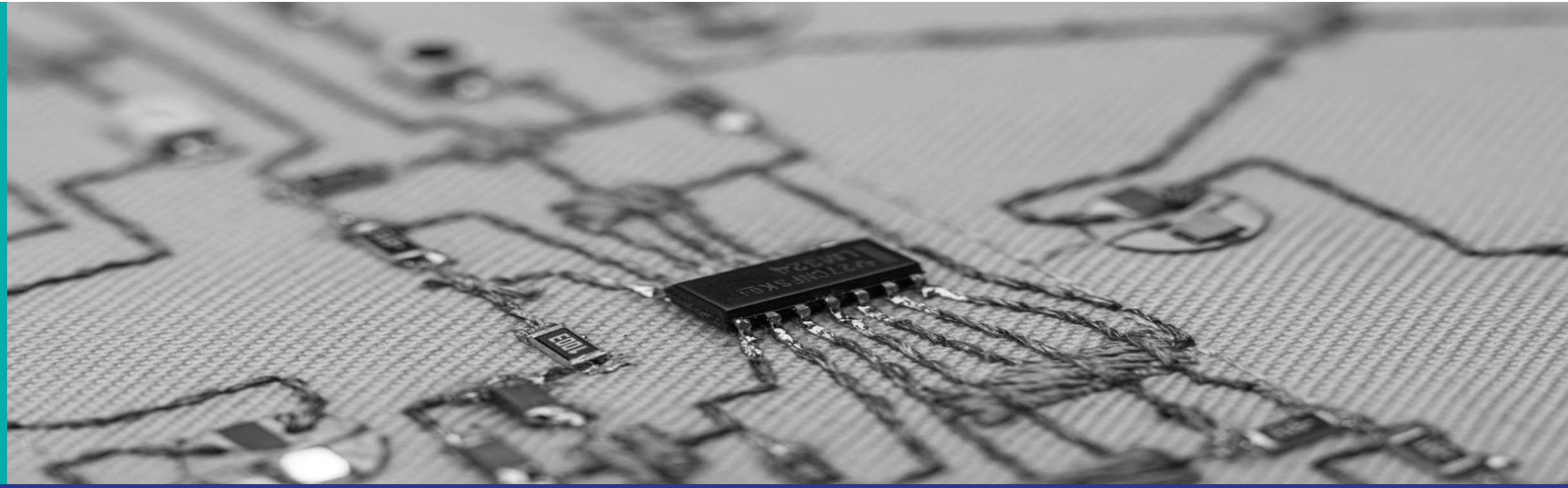


Overview Lecture on our Current Developments in the Field of Surface Functionalisation

Dr. Yvonne Zimmermann

4th Joint Symposium on Nanotechnology

30th May 2022

titv

Agenda

- TITV Greiz – The think tank for high-tech textiles
- Surface Functionalisation of Textile Substrates
  - Printing (Screen Printing, Chromojet Technology)
  - Cold Plasma Spraying
  - Powder Technology
- Surface Functionalisation on Thread Materials
  - Textile Prototyping Lab for Thread Materials
  - Combustion Chemical Vapor Deposition (C-CVD)
  - Metallization
  - Applications and Current Projects
- Conclusions

TITV Greiz – The Think Tank for High-tech Textiles

Headquarter	Greiz/Thuringia (founded in 1992)
Team	60 Experts (interdisciplinary composition)
Technical center	for Thread functionalisation, Weaving, Knitting, Textile finishing, Coating, Printing, Embroidery, Electroplating, Electrical Engineering

Accredited testing laboratory / Smart Textiles testing laboratory

Research priorities:	Smart Textiles / e-textiles Surface functionalisation Technical Textiles / Functional Fabrics

Funded research projects
Individual contract research and development

Conference / Workshops/ Seminars

TITV Background – Experience

From yarns to fabric

- Creating new yarns by using twisting and coating technology including innovative processes like CVD, PVD and electroplating
- Creating unique textile structures by using nearly all possible textile technology like weaving, warp- and flat-knitting, embroidery, braiding

From fabric to functional surface by using and adapting

- Finishing and dyeing processes
- Coating processes
- Printing processes (screen printing, ink-jet and 3D)
- Lamination processes
- Laser processes

From functional fabrics to ready made products for different markets and applications like

- Automotive and new mobility
- Medical devices and sport clothing
- Cleanroom environment and filtration processes

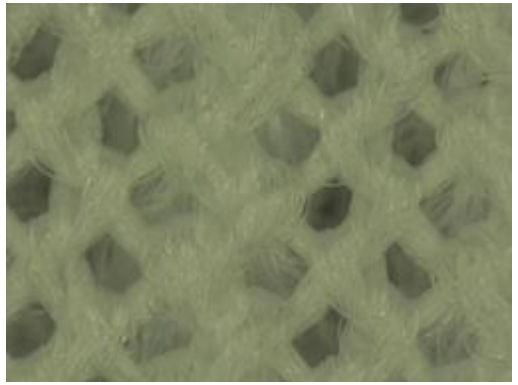
Accredited Testing Laboratory (Accredited acc. to DIN EN ISO/IEC 17025:2005)

- Chemical- analytical tests of textiles and commodities
- Textile-physical tests of fibres, threads and fabrics
- Material testing
- Pollutant analysis
- Testing of reliability of smart textiles


DAkkS
Deutsche Akkreditierungsstelle

Deutsche Akkreditierungsstelle GmbH

Akkreditierung

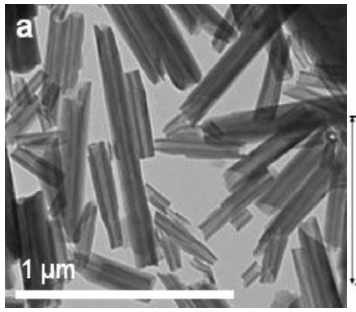


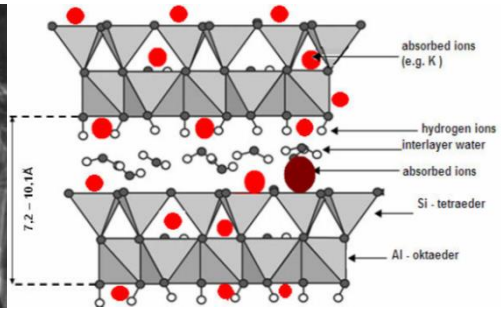
Surface Functionalisation of Textile Substrates:

- Printing
  (Screen Printing, Chromojet Technology)
- Cold Plasma Spraying
- Powder Technology

Screen Printing – Halloysite in UV Protective Textiles

Project: ZIM UV Schutz mit Halloysiten, ZF4250115CJ9

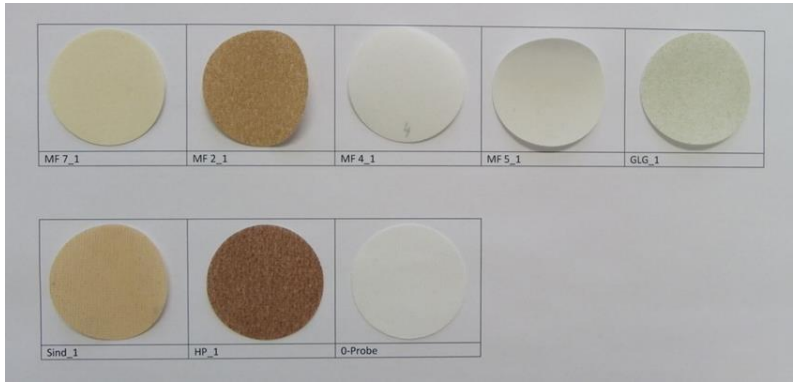




https://en.wikipedia.org/wiki/Halloysite

DURTEC GmbH: Information Halloysite

Overview of the Halloysite used



Gefördert durch:

Bundesministerium für Wirtschaft und Klimaschutz

aufgrund eines Beschlusses des Deutschen Bundestages

ZIM Zentrales Innovationsprogramm Mittelstand

Results Determination of the UV protection factor

sample designation	UVA in %	UVB in %	UPF of the sample	UPF value
without halloysite	10,4	1,9	33,5	34
MF 4 _2 coated, before calendering	7,0	0,7	72,2	> 50
GLG_2 coated, before calendering	5,8	0,7	73,3	> 50
MF 4_2 coated, after calendering	6,1	0,5	97,6	> 50
GLG_2 coated, after calendering	4,4	0,6	96,1	> 50

Possible application examples

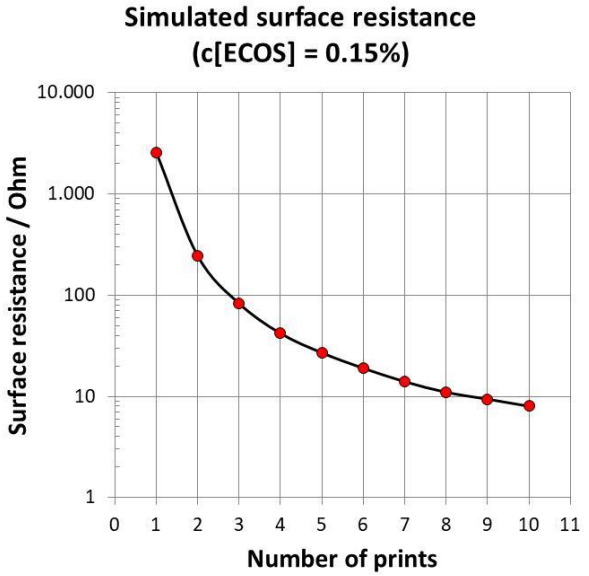
https://www.erfal.de/produkte/sonnenschutz/beschattungsanlagen

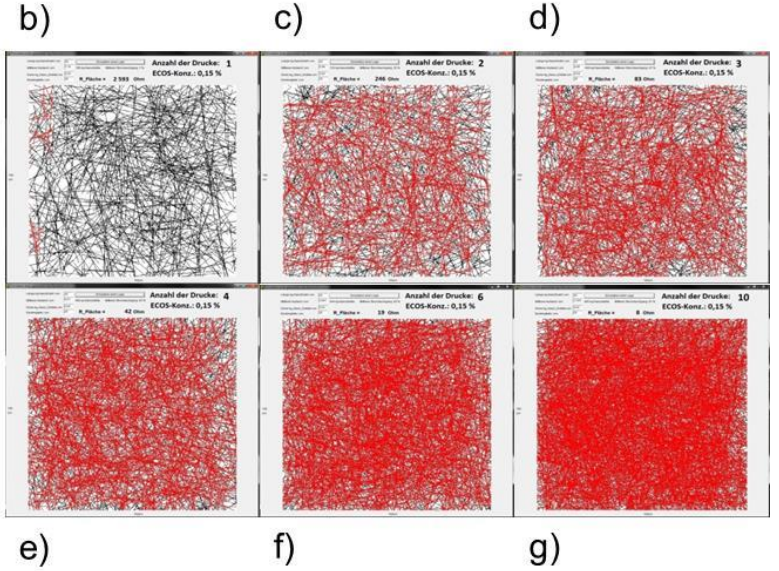
https://www.sueddeutsche.de/ UV-Schutz: Gefahr im Schatten, Stand 28. Juni 2019

Chromojet Technology & Silver Nano Wires

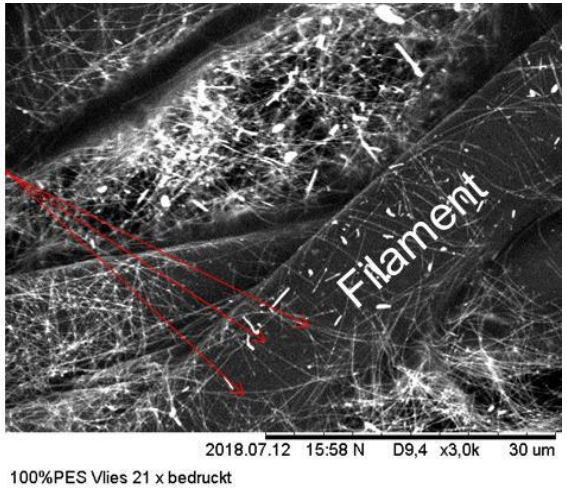
Additional module for printer

Simulation of the distribution of the particles and surface resistance

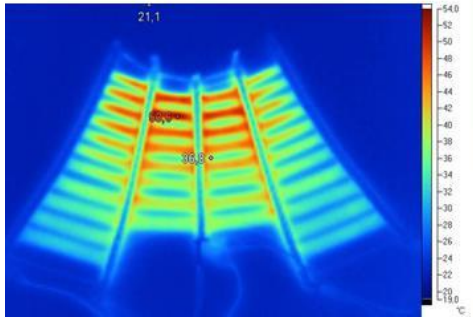




REM image of printed Ag nano wires



Applications



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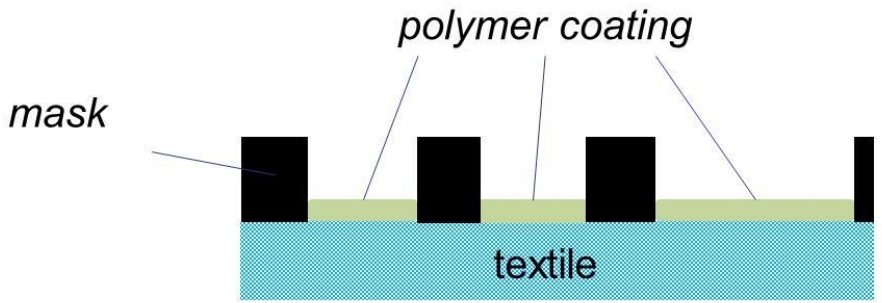
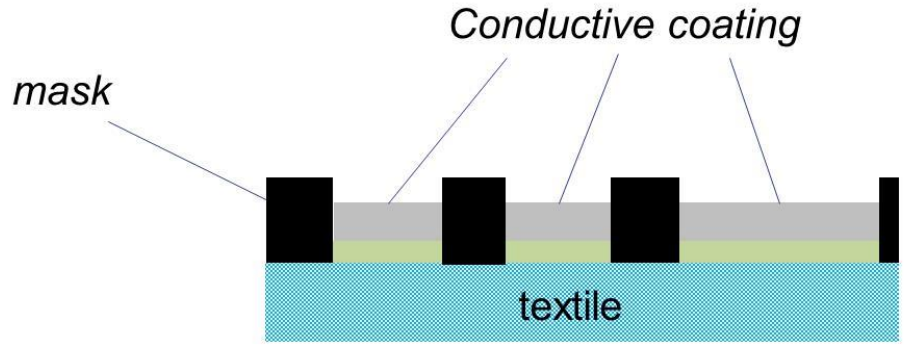
INNO-KOM-Ost

Project: ELTRO-Druck II, INNO-KOM-Ost MF 150063

Cold Plasma Spraying



Application of polymer coating



Application of conductive (metal+ polymer) coating with plasma jet using a stencil for Areal or partial application

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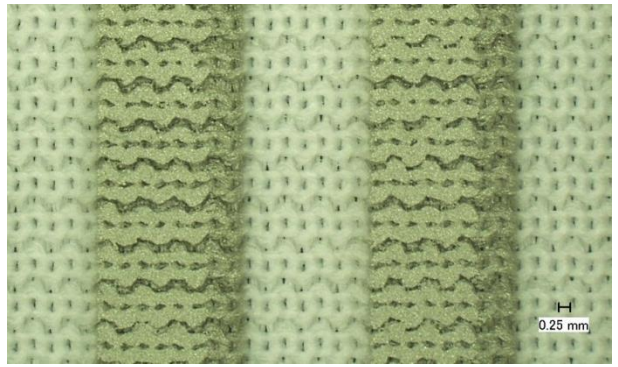
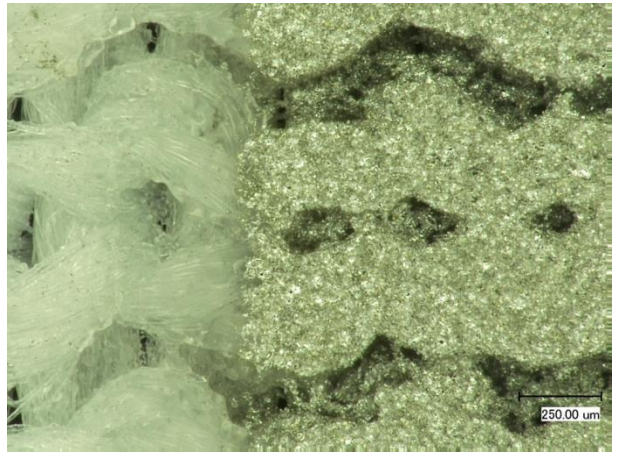
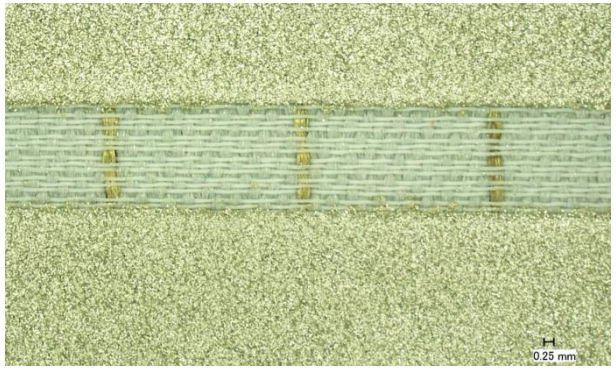


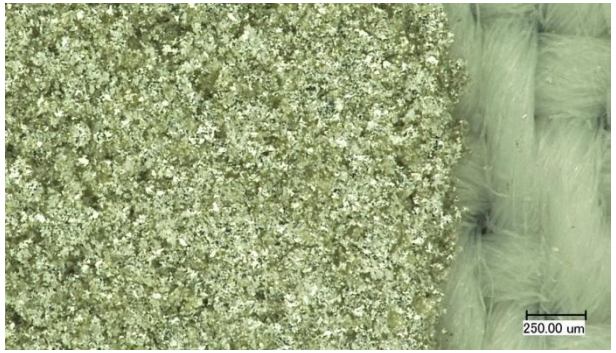


Project: Textiles Kaltplasmaspritzen (Inno-Kom 49VF190011)

Powder Technology

http://eco-coat.com/wp-content/uploads/2017/05/pulver-sorten-1.png *16.3.2021*





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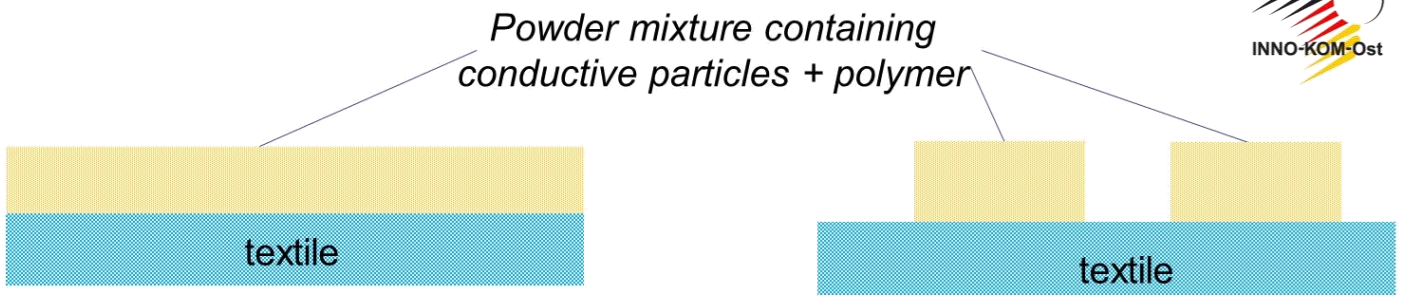
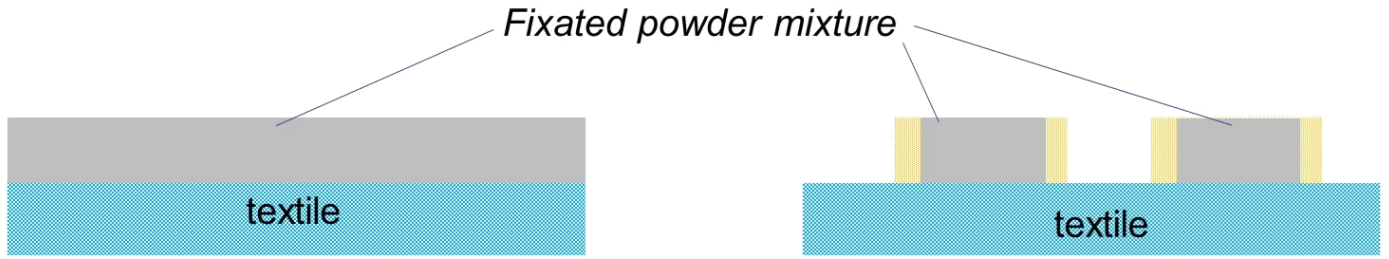


Areal or partial application of conductive powder mixture with a coating knife technique or powder nozzle

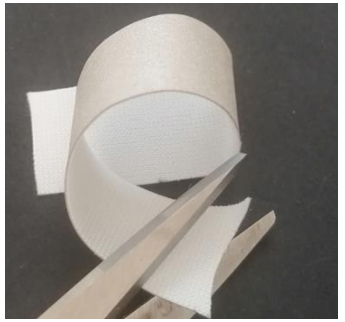


Fixation of applied powder complete or at desired positions by thermal radiation (furnace, laser)

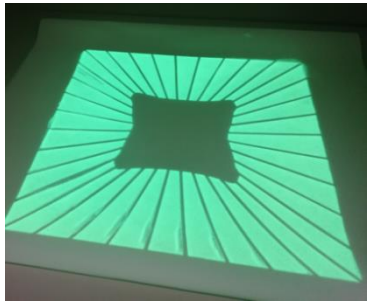
Projects: Pulver DL Fix (Inno-Kom-Ost MF160194), PerMagTex (Inno-Kom 49VF190010)

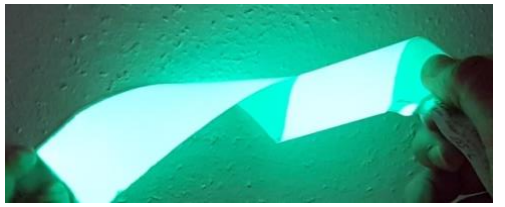
Powder Technology – Different Applications

Electricalyl conductive

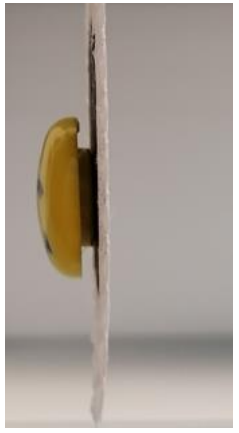


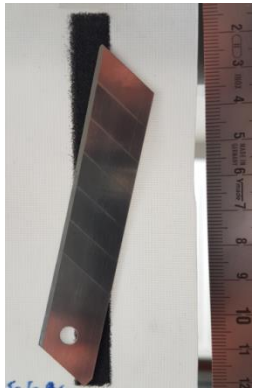
Afterglow



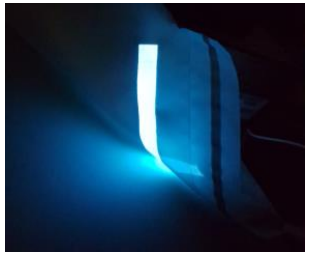


Magnetic





Electroluminescent



Surface Functionalisation on Thread Materials:

- Textile Prototyping Lab for Thread Materials
- Combustion Chemical Vapor Deposition
- Metallization
- Applications and Current Projects

Textile Prototyping Lab for Thread Materials

Ring twister

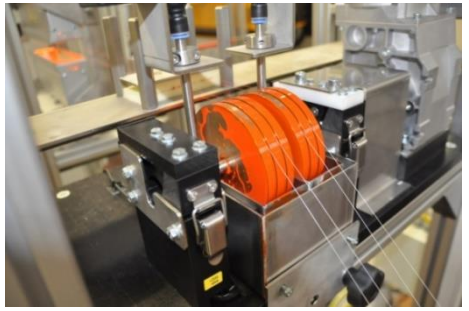
Strength
Protection
Workability

Yarn finishing plant

Pre/post treatment
Activation
Adhesion mediation
Special finishing

Single thread coating system

Flexibility
Resistance
Conductivity
Design effects



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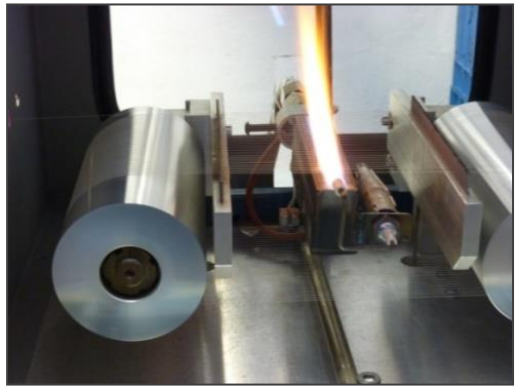
INNO-KOM

futureTEX Zukunft unternehmen!
Gefördert vom Bundesministerium für Bildung und Forschung im Rahmen des Programms Zwanzig20 – Partnerschaft für Innovation.
Zwanzig20 Partnerschaft für Innovation
Bundesministerium für Bildung und Forschung
Deutschland Land der Ideen Ausgezeichneter Ort 2016

Projects: Zwirnmaschine zur Fadenfunktionalisierung (49IZ190017), FutureTex-Invest I + II (03ZZ06X04, 03ZZ0650)

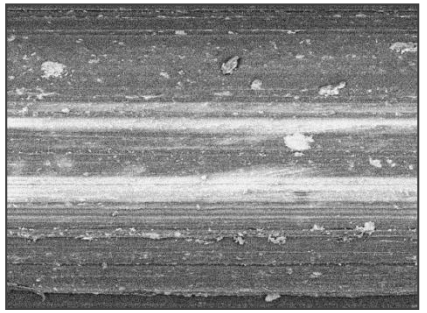
Combustion Chemical Vapour Deposition (C-CVD)

- Deposition of thin films from the gas phase on a solid substrate
- Layer generation through chemical reaction between gaseous starting materials (precursors) and substrate through thermal energy

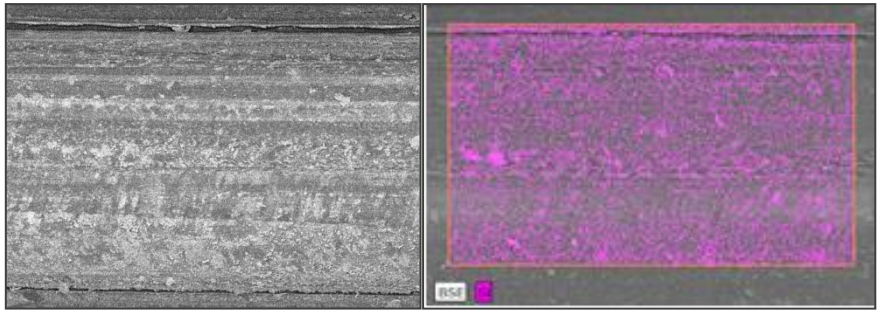


Silica deposition on a polyester monofilament
(SEM and EDX analyses)

Without silica



With 1.9 % silica



With 3.5 % silica

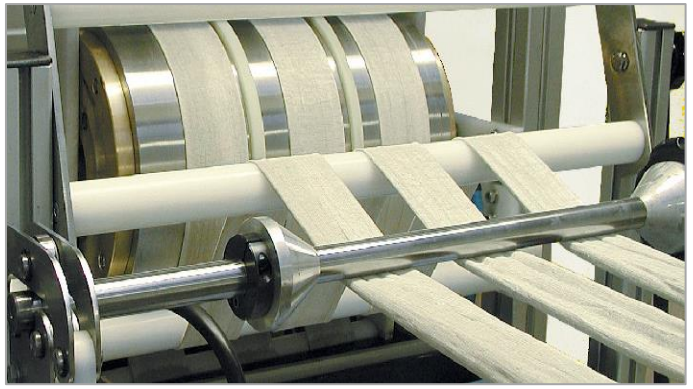
Metallization – silver coated polyamide yarns

Textile electroplating technologies make it possible to produce highly conductive thread materials
ELITEX® is a conductive, textile-processable polyamide thread with a silver coating

Selection of the technology depending on the textile substrate:

- Thread electroplating – continuous electrochemical modification of single threads and twisted yarns
- Knitted fabric electroplating – electrochemical metallization in the knitted fabric

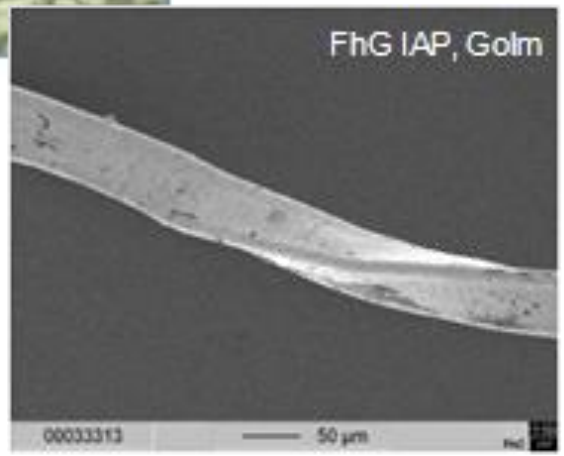
Equipment for knitted fabric electroplating



Project: Galvanotex, BMWA 1131_03

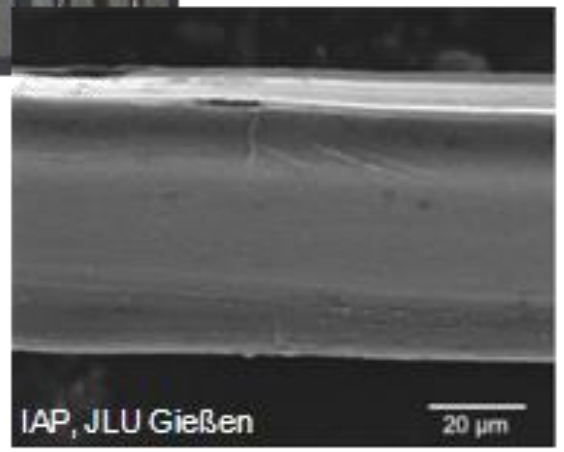
ELITEX® with Improved Surface?

Galvanic deposition on knitted fabrics
leads to defects in the metal layer



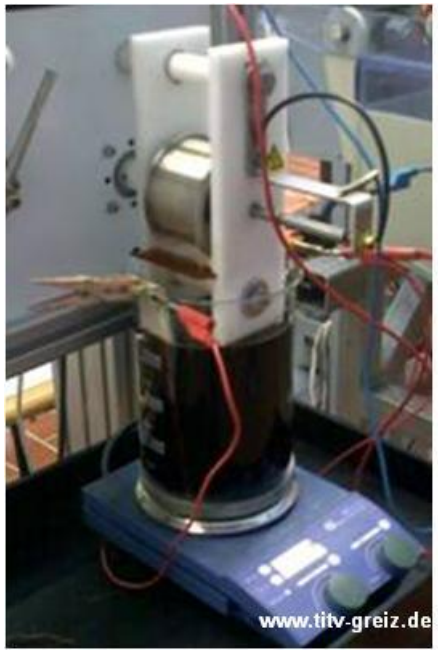
Galvanic deposition on threads
improves the surface of the metal layer

electrodes for laboratory tests



Thread Electroplating – Technical Equipment

Laboratory setups



- Electroplating of silver, gold, platinum, copper, zinc, etc.
- Electrochemical modification of metallized filament materials

Pilot plant

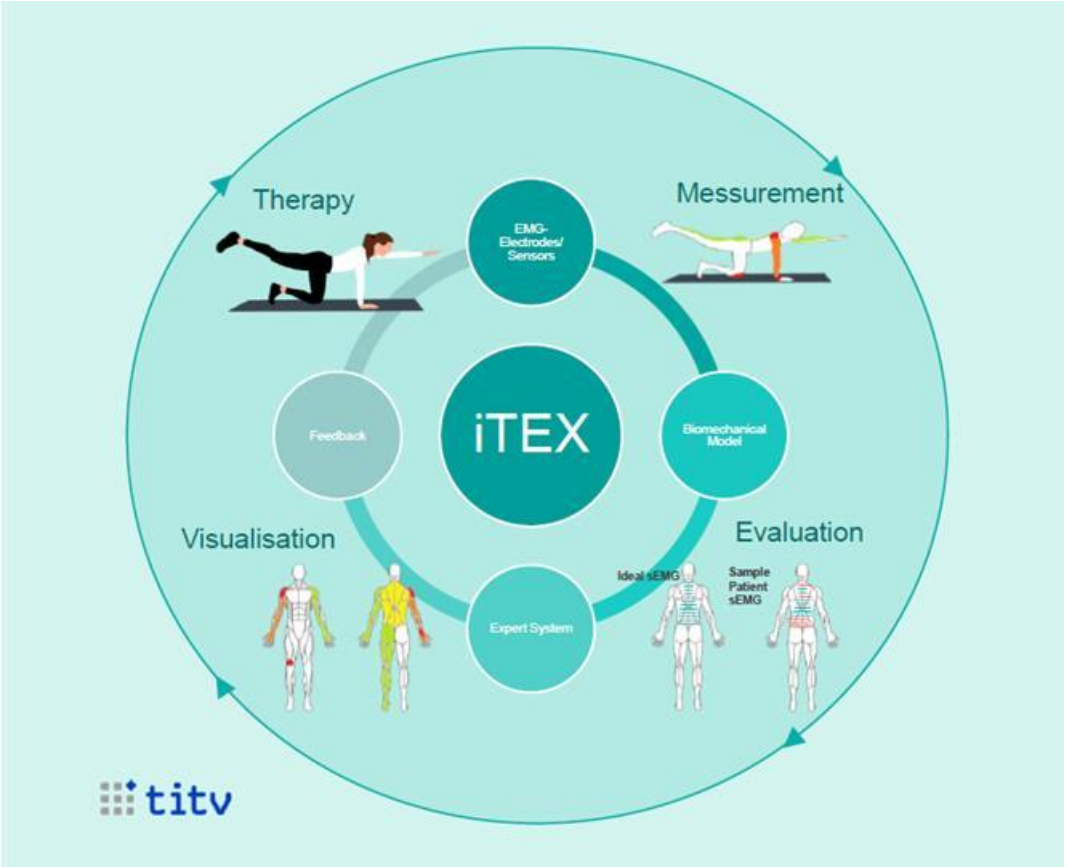
- Electroplating of silver

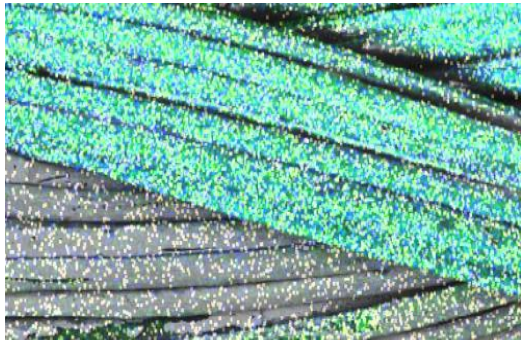
Metallization, C-CVD and Yarn Finishing for Medical Applications

Textile electrodes in telemedicine

Outpatient rehabilitation with online assistance of a therapist for quick diagnosis and treatment in one's own environment

- Textile EMG electrodes to measure the muscle activity
- Allow positioning accuracy
- Resistant to mechanical stress
- Washable





Silver-plated yarn finished with hyaluronic acid after pretreatment with C-CVD

Project:
iTex-4-MoRe – Intelligent textiles for physiotherapy in the mobile rehabilitation (IGF-AIF 21117 BR/2)

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aufgrund eines Beschlusses des Deutschen Bundestages

Single Thread Coating for Heating Application – hiTEX

Application of a carbon-based polymer coating on yarn material by godet application on the pilot plant

Projects: Hochohmiger Faden I + II, Inno-Kom VF150041 and 49MF190140

INNO-KOM-Ost
INNO-KOM
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Bundesministerium für Wirtschaft und Klimaschutz
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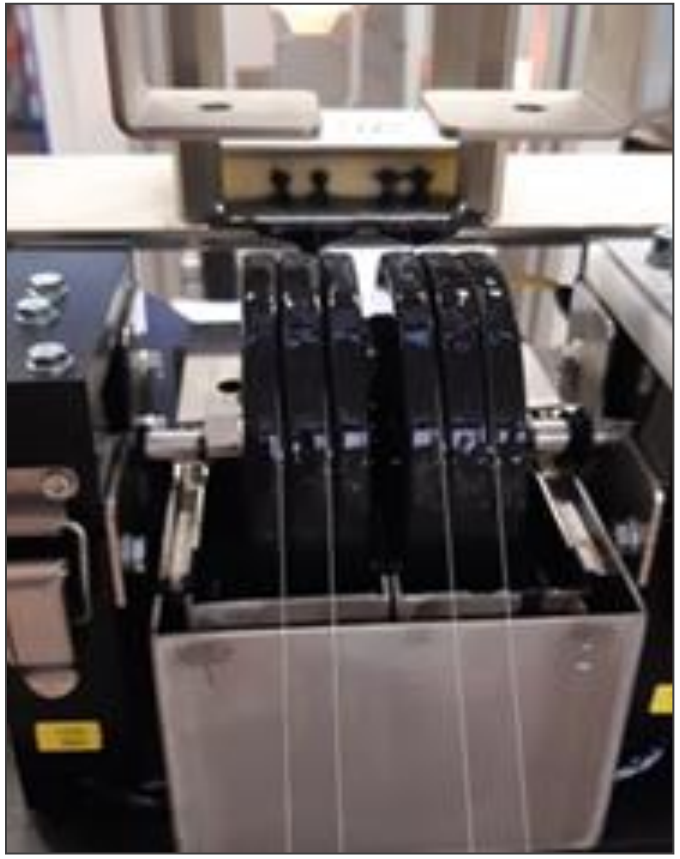
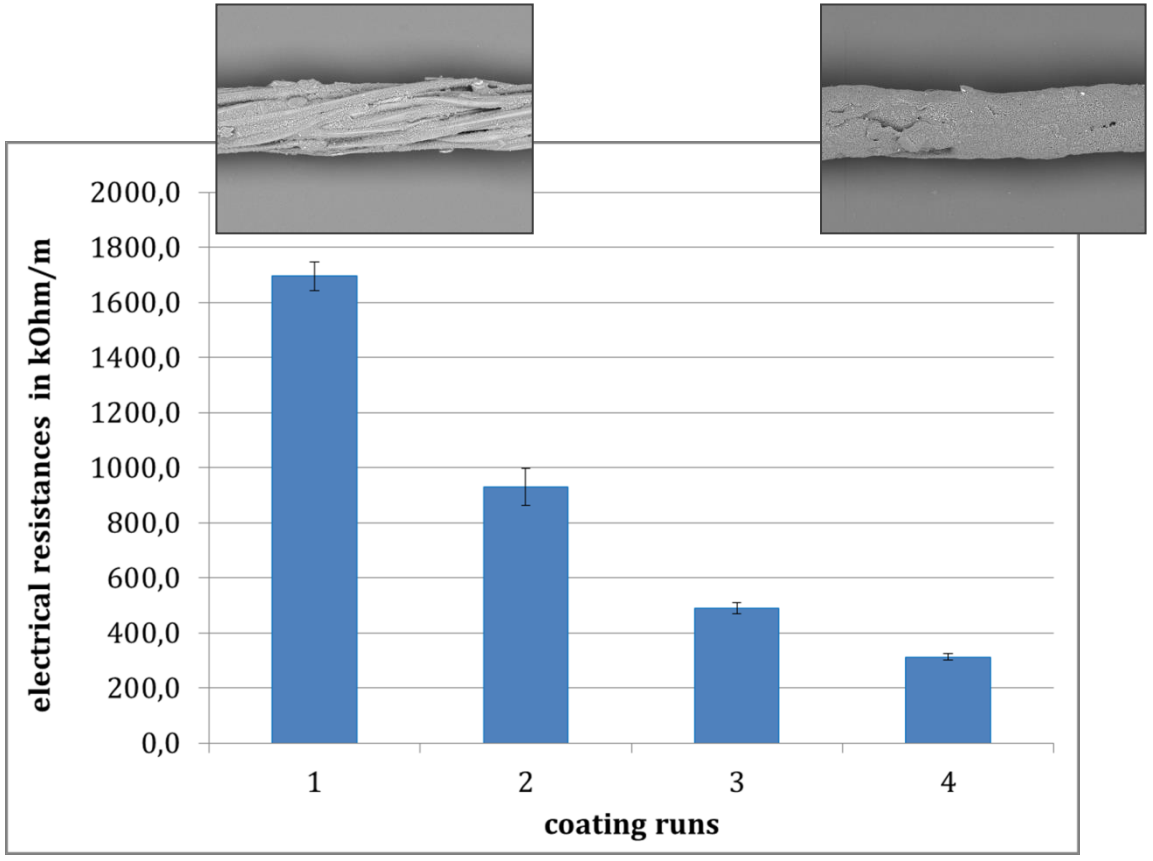
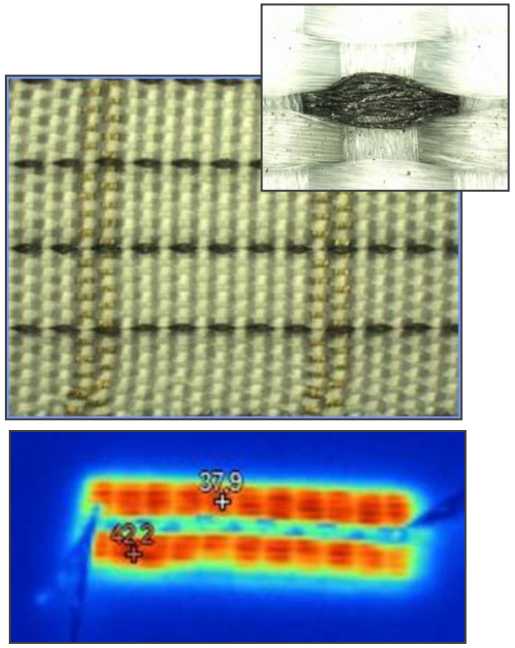
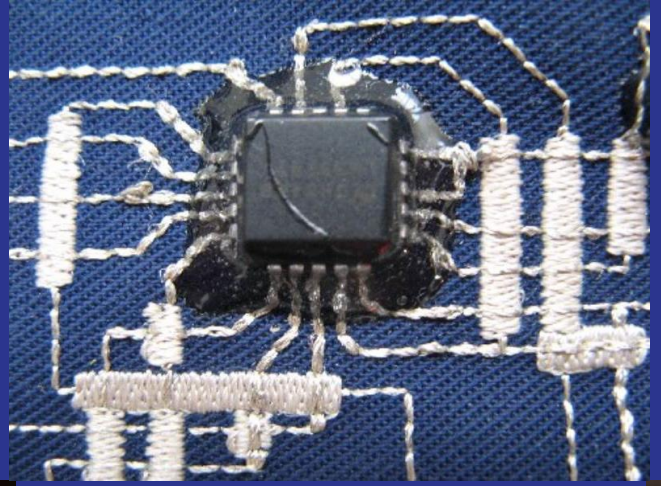






Even heat distribution in the heating tape based on the carbon coated filaments

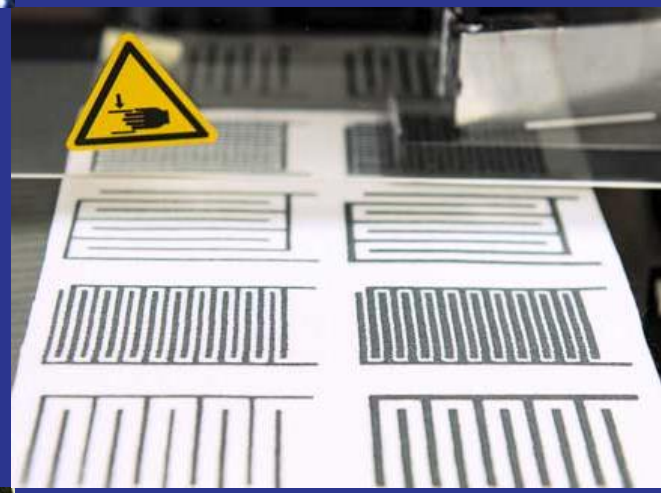
SMART MATERIALS AND PROCESSES



SPECIAL TEXTILES AND FLEXIBLE MATERIALS

SMART TEXTILES

TEXTILE SYSTEM-INTEGRATION



TEXTILE CONSTRUCTION AND CONNECTION TECHNOLOGY

SURFACE TECHNOLOGY

Acknowledgement

To all colleagues involved in TITV Greiz.

All partners from the industry who were involved in the different projects.

We would like to thank the Federal Ministry for Economic Affairs and Climate Action as well as the Federal Ministry of Education and Research for the financial support of the research projects, from which the results could be presented in the lecture.

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aufgrund eines Beschlusses des Deutschen Bundestages

GEFÖRDERT VOM

Bundesministerium für Bildung und Forschung

Thank you very much!

Dr. Yvonne Zimmermann

Mail: y.zimmermann@titv-greiz.de