Security Inks for Textile Applications and other Research Topics of DITF

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German Institutes of Textile and Fiber Research

- Europe’s largest textile research center, approx. 300 employees, 30 Mio € turnover
- Founded in 1921, foundation under public law
- 3 research centers, 1 production company (ITVP)
- Application oriented research from molecule to product on 25,000 m²
- Research with industrial pilot facilities, focus on technical textiles and life sciences
- Connected to University of Stuttgart and Reutlingen University by 3 chairs and 2 professorships
German Institutes of Textile and Fiber Research

Research fields

- High Performance Fibers and Yarns
- Functionalized Textiles and Finishing
- Lightweight Design and Fiber Composites

Application fields (2016)

- Architecture and Construction 8%
- Health and Care 10%
- Mobility 15%
- Energy and Environment 19%
- Production Technologies 38%
- Clothing and Home Textiles 10%

Booth 2036
The Idea of Transparent Security Inks (*Transparency™*)

- Challenge in security marking
  - Invisible for human eye
  - Ink formulation
  - Fastness (fixation of IR-active pigments with binder)
  - Decoding of printed code

Visualisation of transparent codes using IR-light and IR-camera

Decoding of Datamatrix-Codes

Communication with Database server
IR-activity of particles and binders

Selection of ink ingredients

- Selection of pigments on basis of
  - IR-contrast
  - VIS-Transparency
  - Dispersion stability
  - Filterability

- Selection of binders on basis of
  - VIS-Transparency
  - Printability, filterability
  - Soft hand
  - High fastness level
  - Compatibility with pigments
Ink formulation

- **Manufacturing of pigment dispersions**
  - 4h grinding of pigments (IR-active pigments and dispersants in nanomill (picoline))
  - Particle size <100 nm
  - 26 IR-additives under investigation

- **Addition of chemicals**
  - Dilution (< 0.1% IR)
  - Binders (5%)
  - Additives (up to 5%)

- **Filtration**
  - Filtration down to 0.8 μm
  - Particle size < 100nm

Viscosity $\eta = 1.43$ mPas
Surf. tension $\sigma = 33.9$ mN/m
Measurement setup for the detection of security tags

Parameters

• Recording time 30 sec
• IR-Exposure time 20 sec
• Code size 5cm*5cm

IR camera

Textile sample without IR-radiation

Textile sample with IR-radiation

NIR flood light
# Properties of Transparency™ Ink

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<tr>
<th></th>
<th>Paper</th>
<th>Co R122</th>
<th>PET foil</th>
<th>PET ecodis p210</th>
<th>PA R69</th>
<th>Conex R132</th>
<th>Kevlar</th>
<th>Leather crust</th>
<th>PVC</th>
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<tbody>
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<td>Printability</td>
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<td>Resistant to rubbing (dry) Rubbing (wet)</td>
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<td>Detection &amp; Decoding</td>
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Visualisation of security code using IR-radiation & IR-camera

Security inks (Transparency™)
Inkjet printing of datamatrix code
- Invisible for human eye
- High fastness level
- Decodable
Digital printing of functional layers on textiles

Expertise
- Pre-treatment for inkjet printing
- Ink formulation
- Functional inks

- Electrical switch
  - Pressure sensitive pad based on ohmic resistance and capacitance (on/off switch)

- Sensors for composites
  - Deformation sensitive structures based on ohmic resistance (measurement of mechanical stress)

- Heating element
  - Electroluminescence
  - UV-active
Functionalization of Textiles using Ionic Liquids

Expertise
- Formulation of coatings out of ionic liquids
- New material combinations

Ionic liquids (ILs) as solvent for
- Chitin
- Cellulose
- Polyamide Aramide

Excellent adhesion on various substrates (PA, PET, Co..)

Morphology depends on coating polymer

Coated and uncoated cotton fabric with chitin/IL solution
PURCELL – a Sustainable Composite Material of Pure Cellulose

The PURCELL principle and approach

- Biopolymer cellulose is used as both, the reinforcement fiber and the matrix material.
- Reinforcement cellulosic fibers are used in form of textiles.
- The cellulosic matrix is realized with pure cellulose dissolved in an ionic liquid.
- The composite material is built up layer by layer via impregnation of the respective textile.
- Subsequently, IL is removed in a water bath.
- The composite material is dried and consolidated via hot pressing.

Fiber reinforced composite made of pure cellulose

- Excellent fibre-matrix adhesion
- Recyclable, biodegradable
- Good mechanical performance
Development of Ceramic Fibers for High Temperature Light Weight Construction

- Pilotline for the development of continuous oxide ceramic fibers (alumina, mullite etc. (kg scale) at DITF.
- Long term temperature resistance above 1000°C.
- Ceramic fibers determine the performance of CMCs (ceramic matrix composites).
- Ceramic matrix composites are new non brittle ceramic materials (fiber reinforced ceramics) with high potential for different technical applications.
- Potential fields of application: aerospace, power engineering, industrial furnaces, batch racks for temperature treatment...

The Future is Textile