ENSAIT,

French Grande Ecole, one of the leading textile schools in Europe

The staff

40 Professors
22 Engineers and technicians
33 Administrative staff

The students

426 Engineering students
367 in initial training
59 in apprenticeship
49 PhD students

GEMTEX Research Lab.

Key figures

12 full Professors
16 associate Professors
7 Visiting Scholar
49 PhD Students
3 Engineers
3 Technicians
2 Administrative staff
8 temporary Researchers/Engineers
TOTAL: 104 members

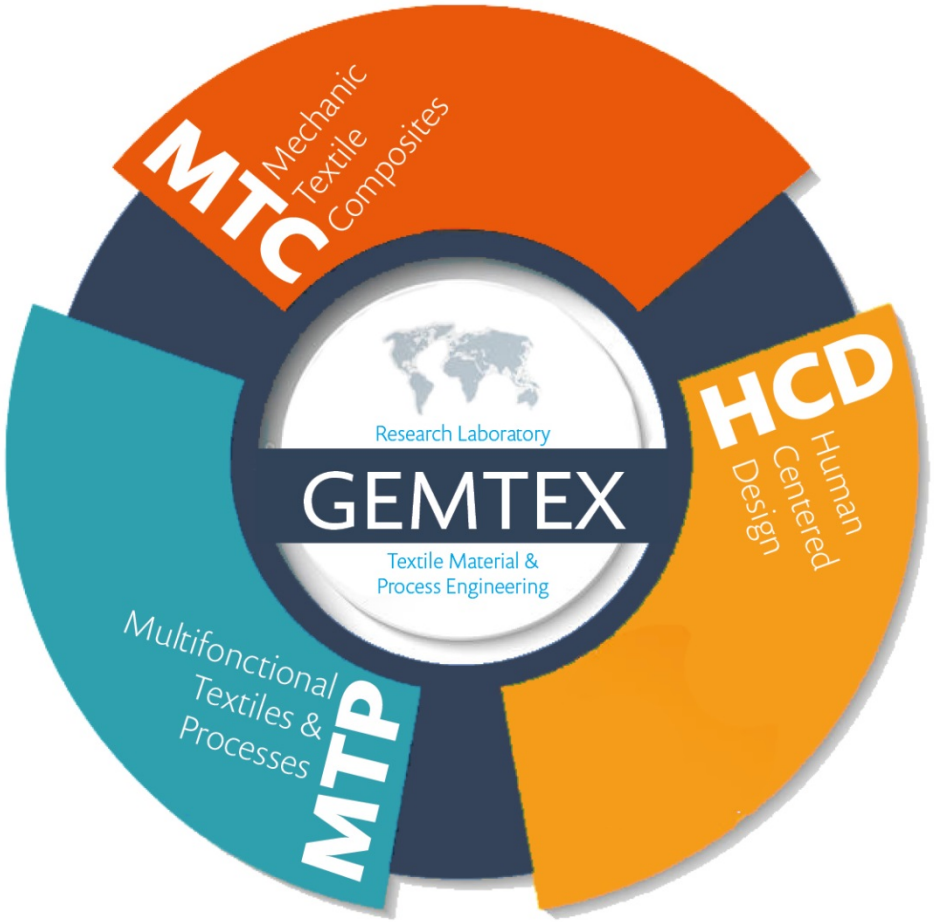
36 SCI papers in 2017

Annual Turnover: 4.7 M€ (2017)

Funding:

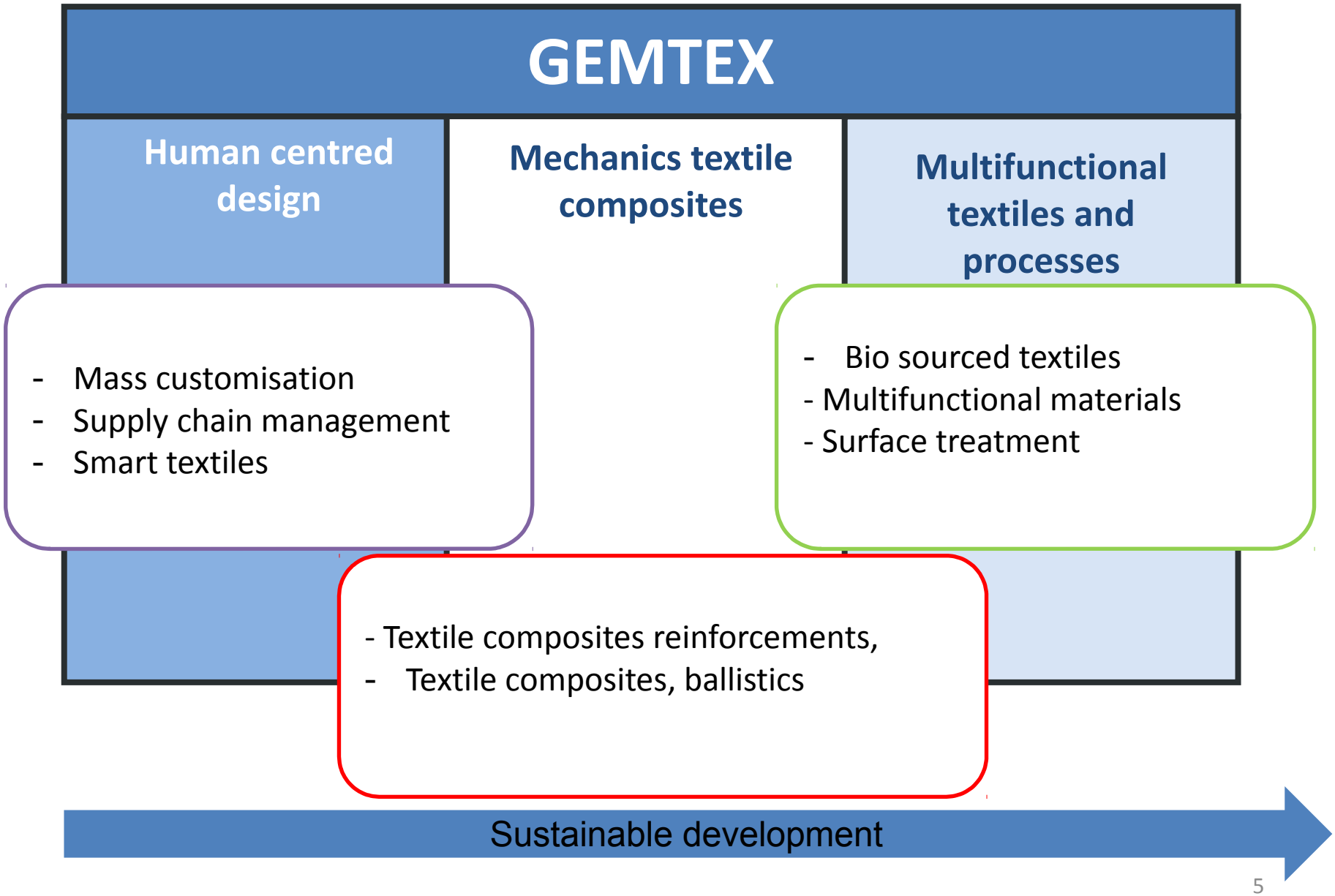
State	24 industrial projects	37 collaborative projects

GEMTEX Scientific Structure



ONE RESEARCH TEAM - TEXTILES ADVANCED MATERIALS

GEMTEX Scientific Structure



Multi-scale Textile

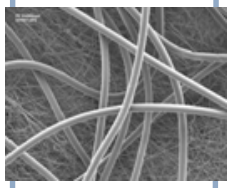
Choice of polymers and materials **(fillers, nanofillers, microcapsules,…)**

50nm 300nm 1µm 10µm 25µm 50µm+

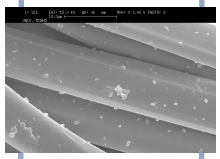
Fibres

nanofibres

submicronics fibres

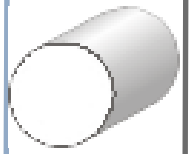


microfibres



Fine fibres

Coarse fibres



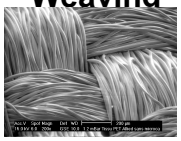
Yarns

multi-filaments

Spun yarn

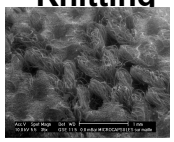
Structure Textiles

Weaving

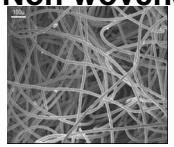


Braiding

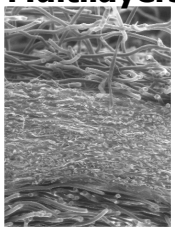
Knitting



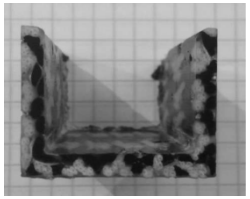
Non wovens

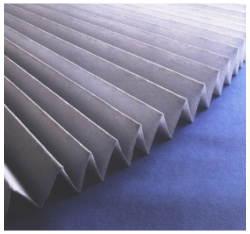


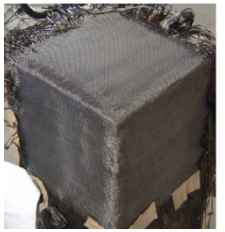
Multilayers



Complex structure



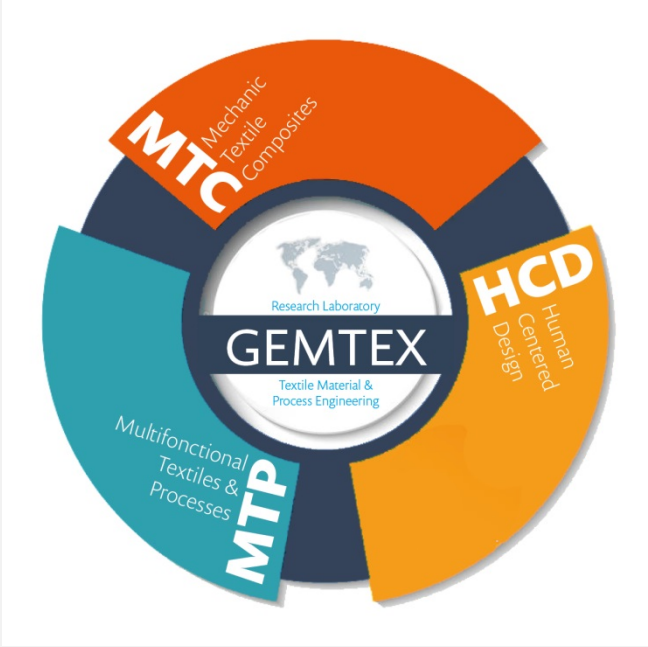




GEMTEX Scientific Structure

KeyWords for MTP: Surface functions, Interfaces, sensors – sctuators, smart textiles, non-wovens, functional fibers, …

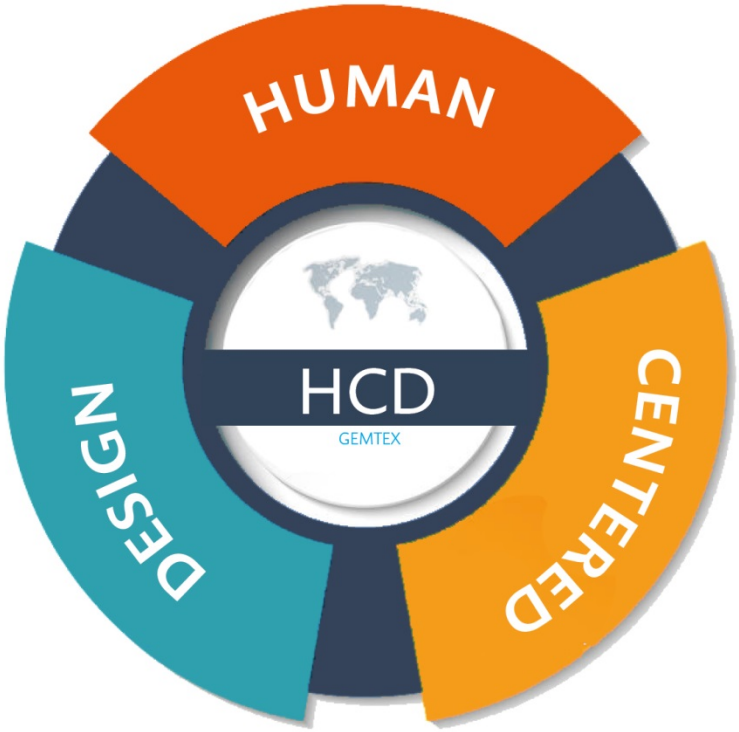
KeyWords for HCD Goup: Decision support system, modelling and optimization of products, processes and organizational systems, human factors: perception, cognition and man/material/environment interactions, instrumentation and control



Keys-words for MTC: Design, implementation, optimization of Textile Structures and their innovative processes fabrication - Characterization and modelling of textiles structures - Hybridization Textile Technology

ONE RESEARCH TEAM - TEXTILES ADVANCED MATERIALS

GEMTEX Research Laboratory



Human Centered Design (HCD)

- Decision support system
- Modelling and optimization of products, processes and organizational systems
- Human factors: perception, cognition and Man/Material/environment interactions
- Instrumentation and Control

ONE RESEARCH TEAM - TEXTILES ADVANCED MATERIALS

HCD group: Human Centered Design

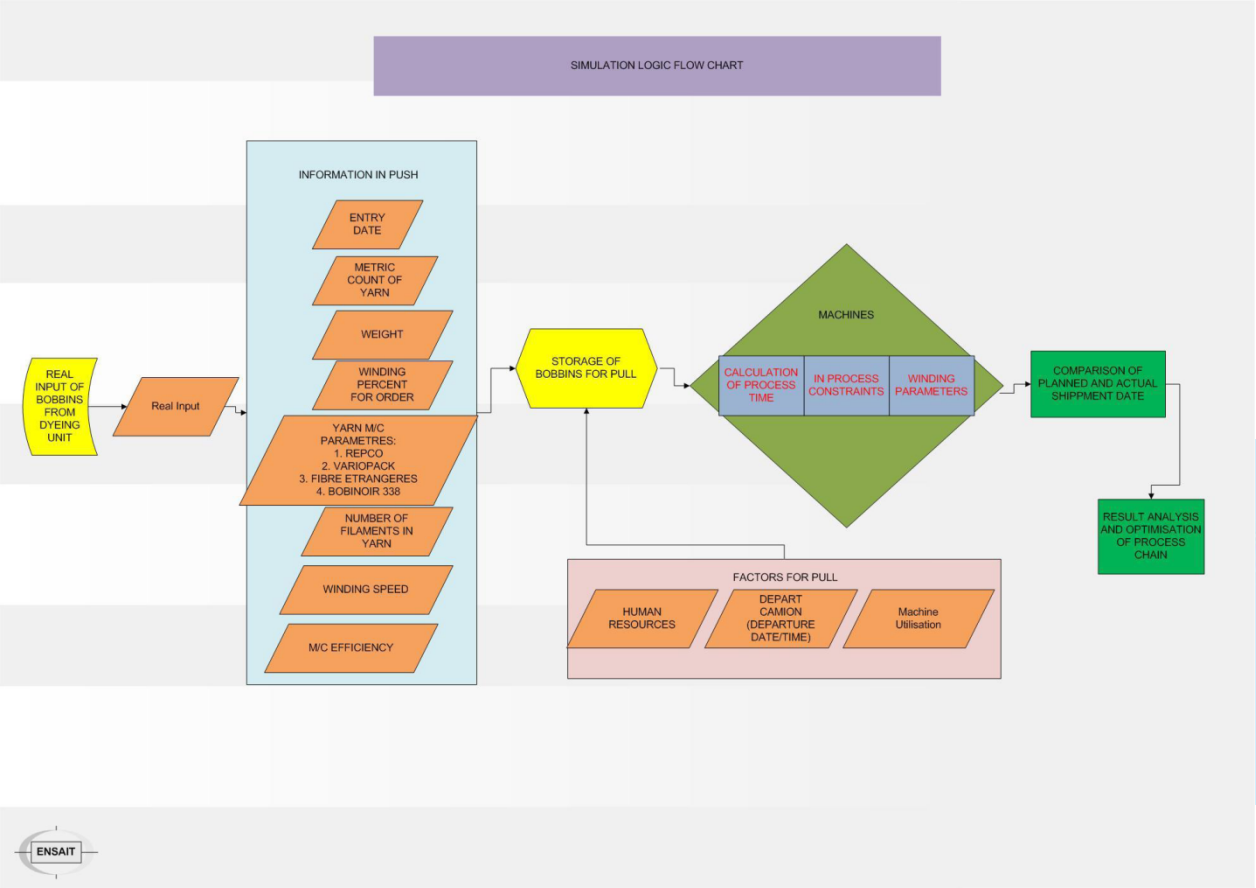
Team

- senior Professors: Pascal Bruniaux, Ludovic Koehl, Vladan Koncar, Xianyi Zeng
- Assistant-Professors: Xuyuan Tao, Sébastien Thomassey, Guillaume Tartare
- SCI papers since 2010: >85
- Research projects since 2010: 2 European projects, 8 national projects (FUI, ANR), 2 regional projects, 10 industrial projects

HCD group: Human Centered Design

Optimization of supply chain and production

modelling and simulation, sales forecasting, cost estimation, supplier selection, life cycle analysis, small series organization, mass customization

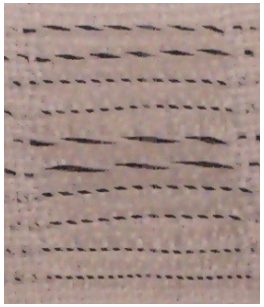


HCD group: Human Centered Design

Optimization of the supply chain and production

tracking => creation of textile Tags

Woven fabric with embedded tag



Tag, coding and PDM/PLM system

HCD group: Human Centered Design

- **Creation of 3D virtual garments and their numerical chain**

human modelling, virtual try-on, co-design, recommandation systems, comfort, co-design platform

consumers

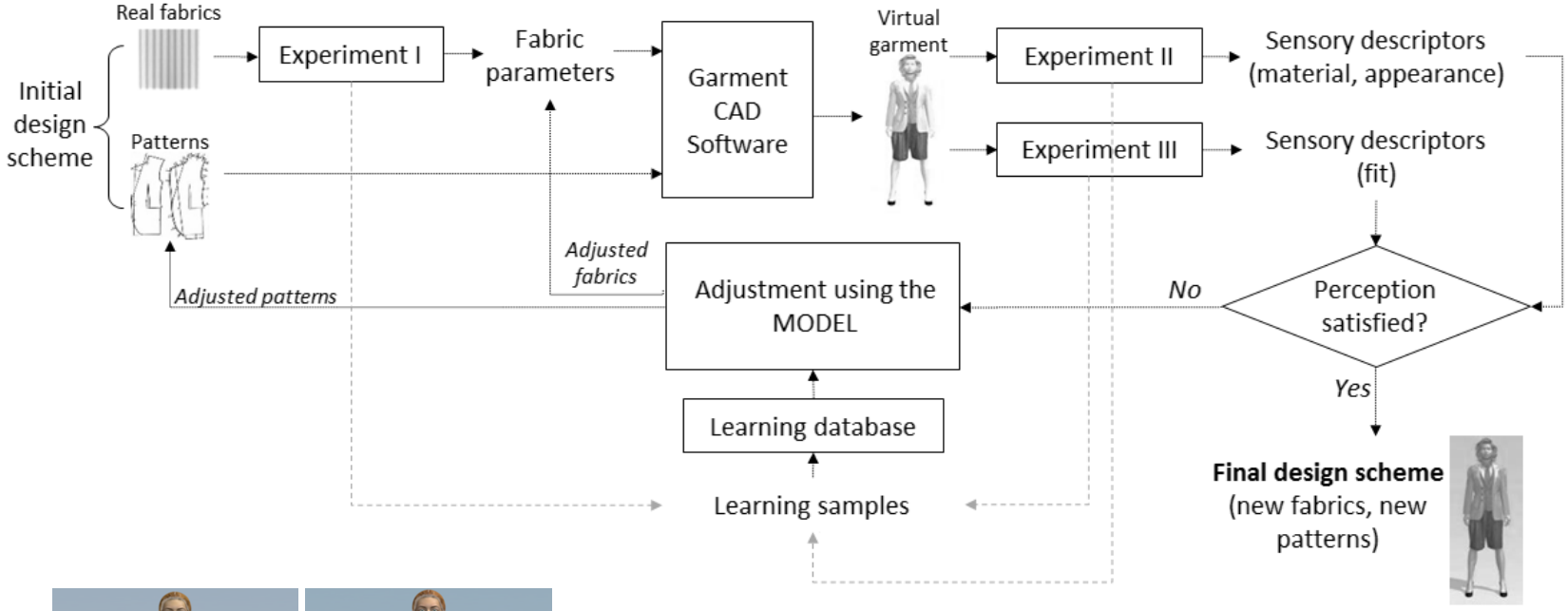
designers

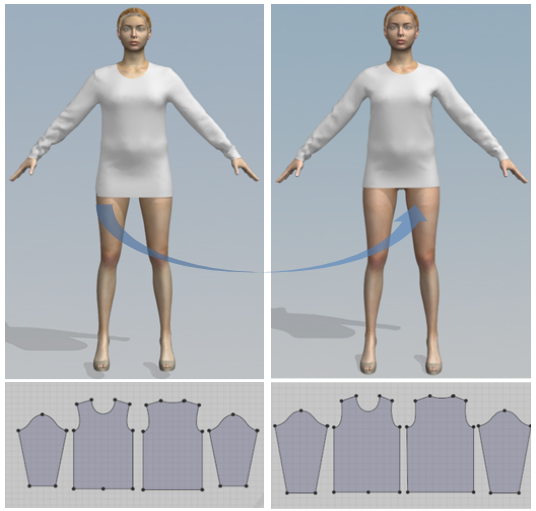
producers

shops

HCD group: Human Centered Design

➢ Creation of 3D virtual garments and their numerical chain

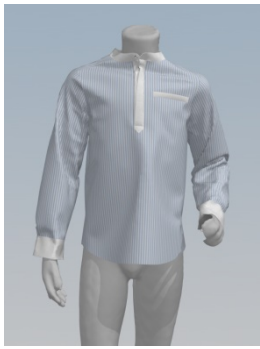




Initial prototype

Less flexible

More flexible



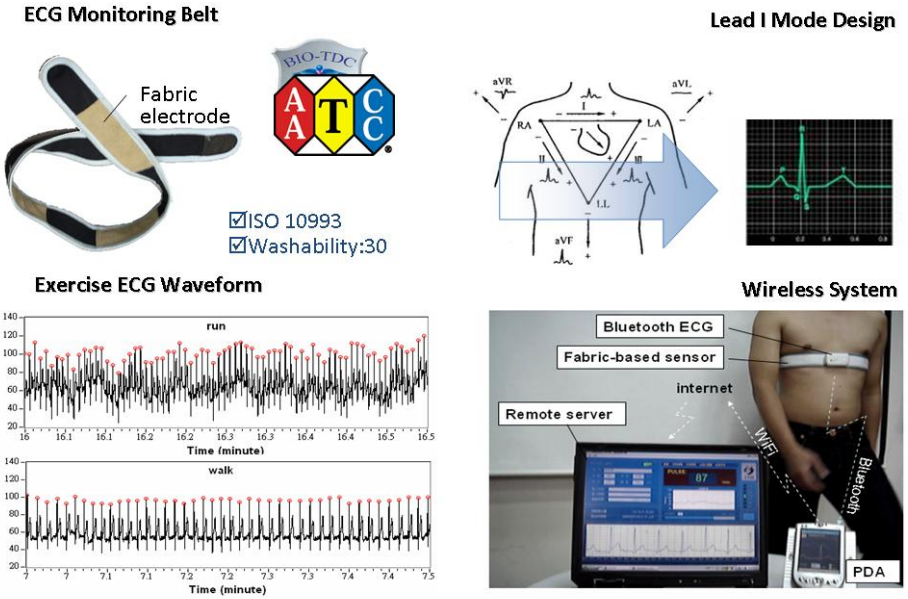
HCD group: Human Centered Design

➢ Intelligent textile

Flexible sensors and actuators, instrumented garment design, signal processing, decision support systems, medical applications, dedicated textiles for severe conditions: firemen, …

An intelligent clothing with sporty physiological inspection

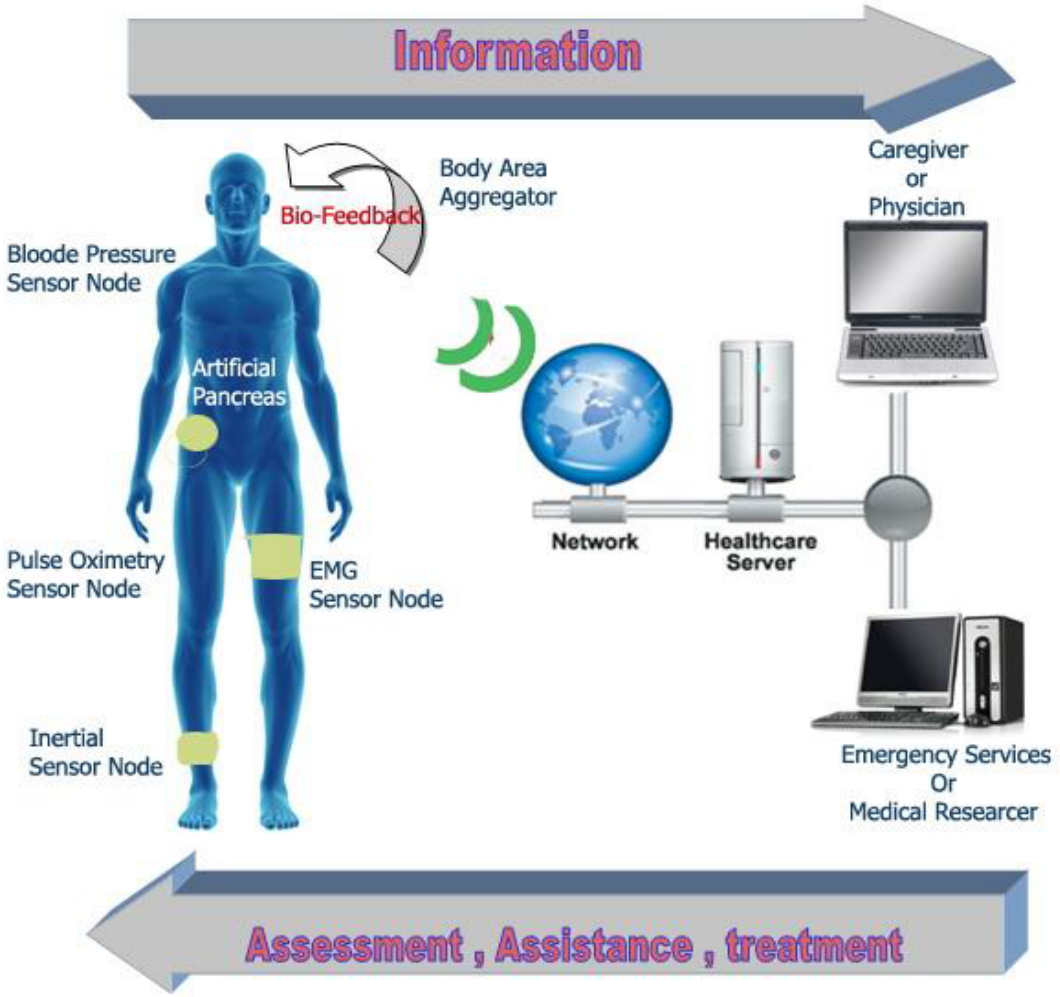
Wireless Exercise ECG Monitoring System

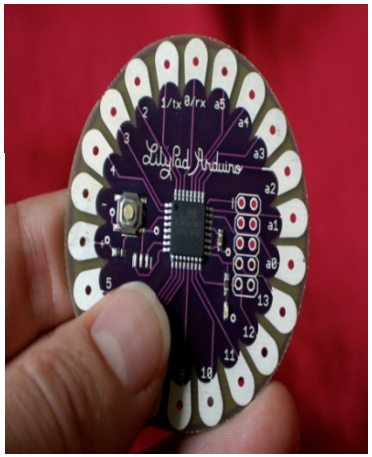


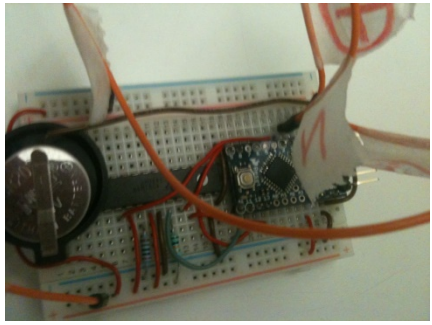
HCD group: Human Centered Design

➢ Intelligent textile

E-health or remote health monitoring







Components:

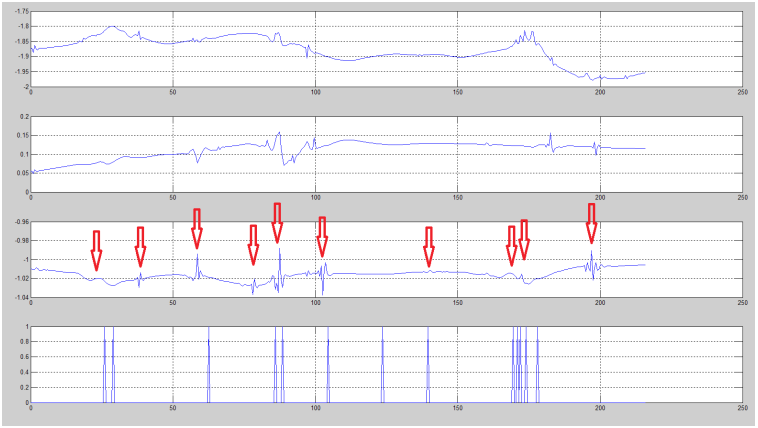
- Physiological sensors
- Connected garment
- Local diagnosis
- Cloud computing platform
- User interaction
- Global diagnosis
- Big data collection
- Self-learning

HCD group: Human Centered Design

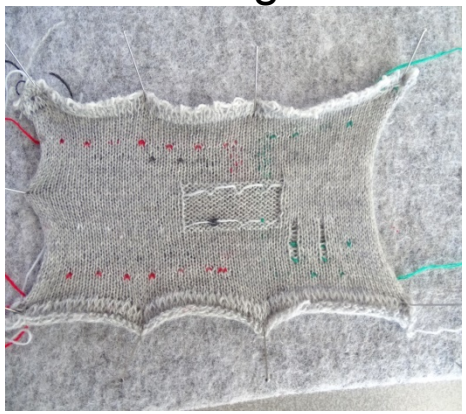
- **Intelligent textile :** remote health monitoring

Pregnant women's belt

Fetal movement detection



Conducting thread



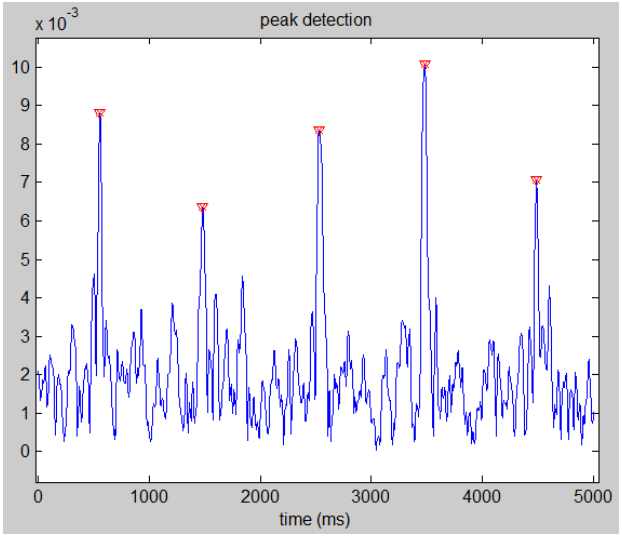
Accelerometers

⇓

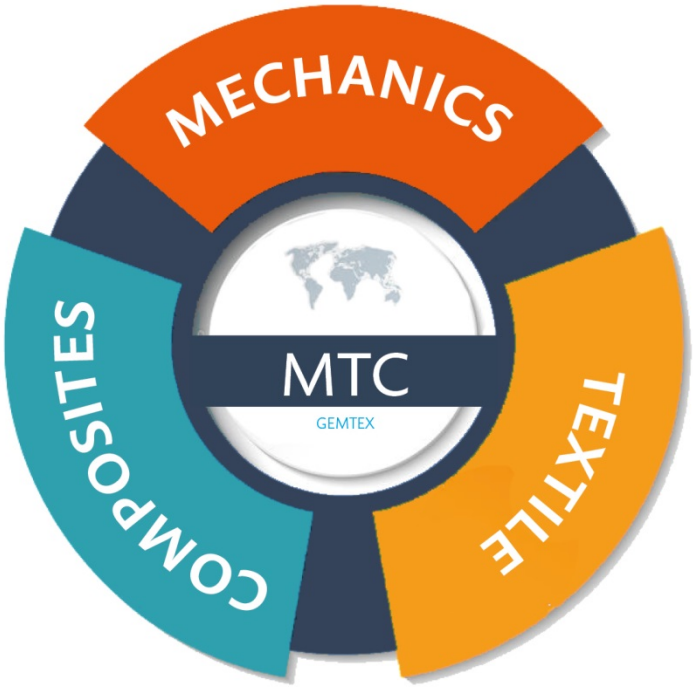
Heart rythm monitoring

⇓

Signal processing



GEMTEX Scientific Structure

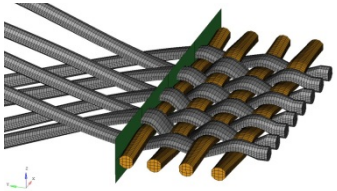
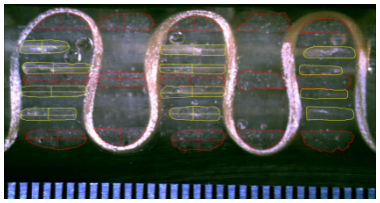
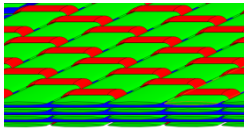


Design,
Implementation,
Optimization of structures and innovative processes
Manufacture
Characterization and modelling of structures
Hybridization Textile Technology

ONE RESEARCH TEAM - TEXTILES ADVANCED MATERIALS

MTC: Mechanics - Textile Composites



- Design – Textile processes
- Fiber/textile reinforcements
- Modeling of textile structures

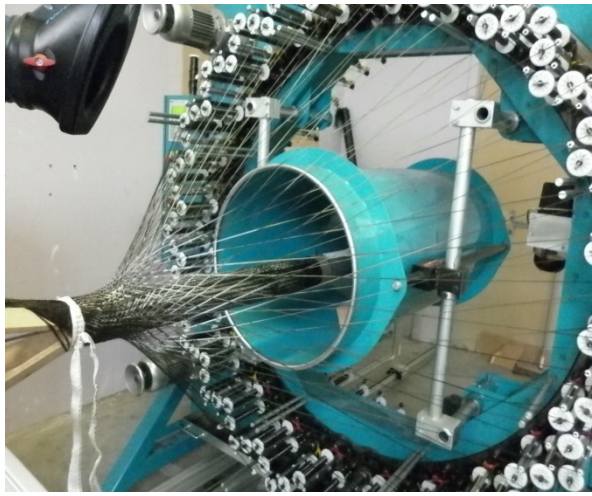
Applications

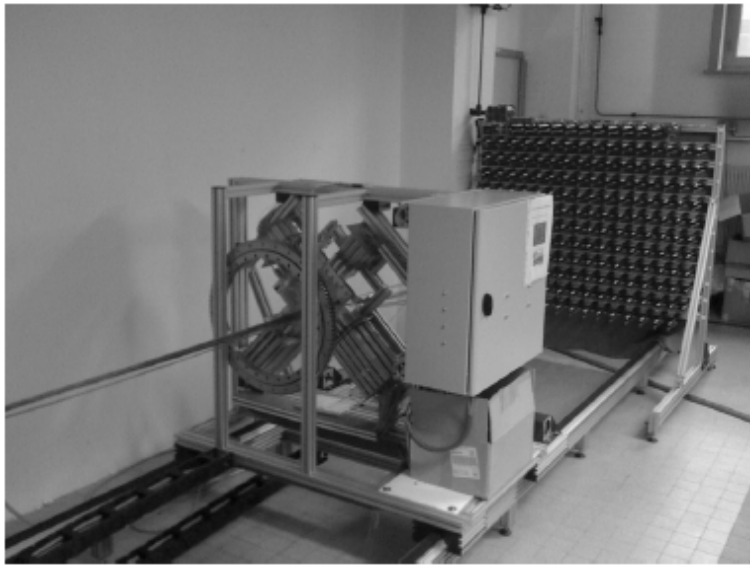
*<u>Composites for structures</u>
Automotive field

*<u>Composites for protection</u>
ballistics

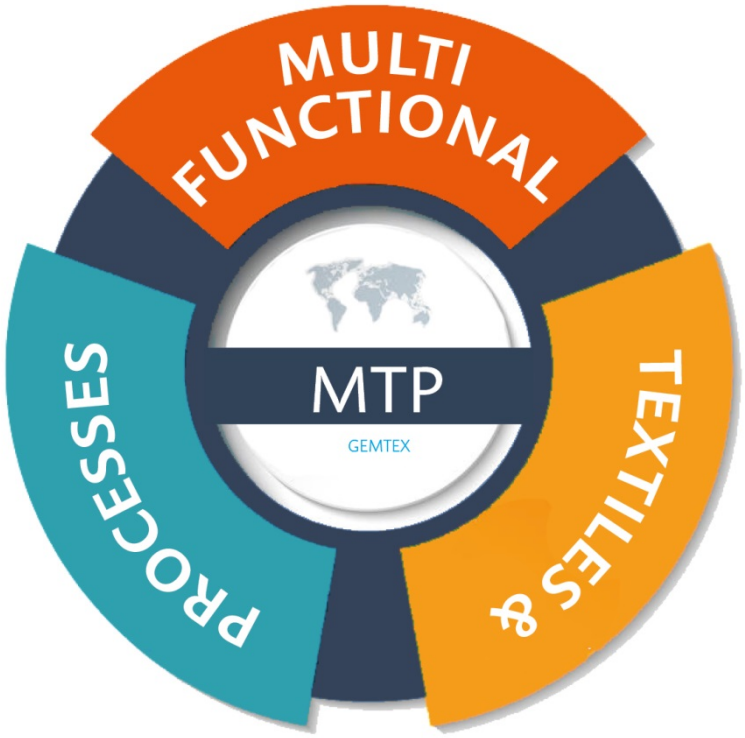
MTC: Mechanics - Textile Composites

Weaving (2D-3DInterlock-Multiaxis) , Braiding, Fibers/Threads reinforcement (stiching), hybrid techniques,….)





GEMTEX Scientific Structure



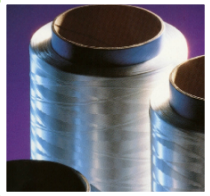
Surface functions,
Interfaces,
Sensors – actuators
Smart textiles
Nonwovens
Functional fibers

ONE RESEARCH TEAM - TEXTILES ADVANCED MATERIALS

MTP: Multifunctional textiles and Processes

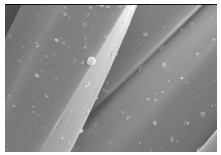
Development of functional multifilament :

- Nanofillers in polymers by melt spinning
- Spinning of biopolymers



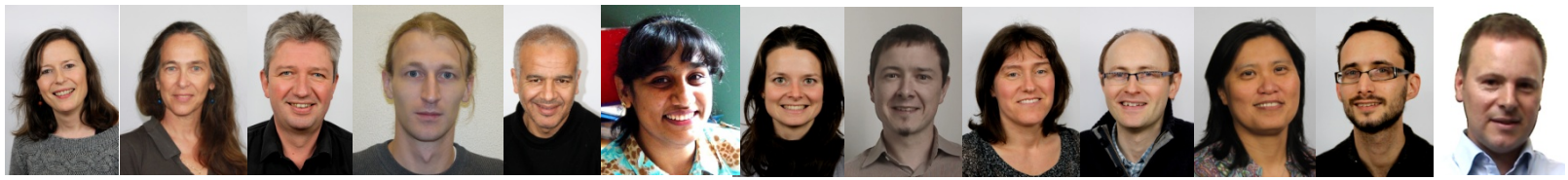
Functionalization of textile surfaces

- By physical treatment : atmospheric plasma
- By chemical treatment : development of nano/micro capsules, grafting of microcapsules, functional coating at the surface of fibres



Development of advanced textile structures (weaving, knitting, nonwoven) with a controled structure.

•Optimization and control of processes parameters for the development of functional properties.



Development of functional fibres

- Introduction of nanoparticles by melt spinning
- Spinning of biopolymers
- Blending of thermoplastic polymers

Pilote de filage par voie fondue
(Spinboy I of Busschaert Engineering)

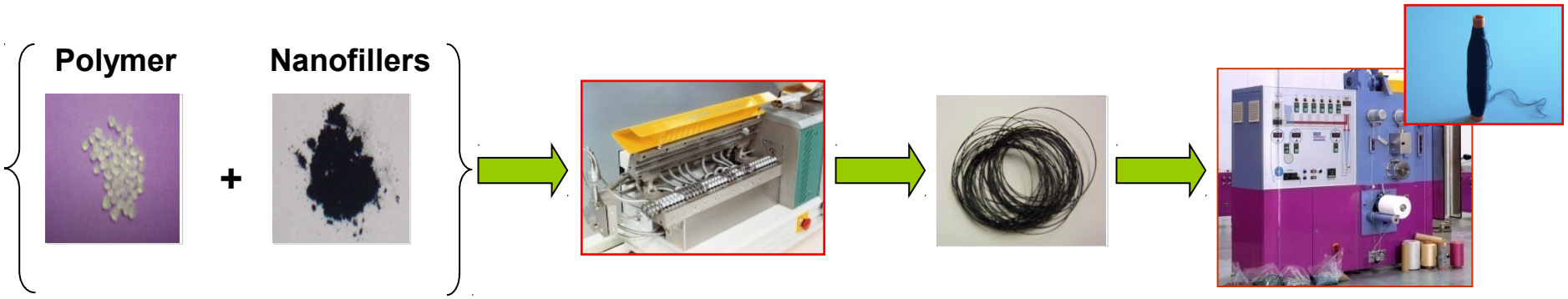
Exemple de projets :

NANOLAC
INTERREG IV France • Wallonie • Vlaanderen
ims &cps
7ème PCRD
filairco
MateriaNova MATERIALS R&D CENTRE
UMET Unité Matériaux Et Transformations
KATHOLIEKE UNIVERSITEIT LEUVEN
imp
Queen Mary University of London
LRGP

Development of functional fibres

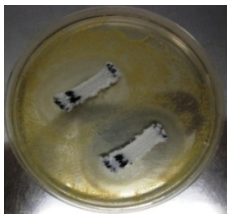
Nanostructuration of polymers

Incorporation of nanofillers for functional properties

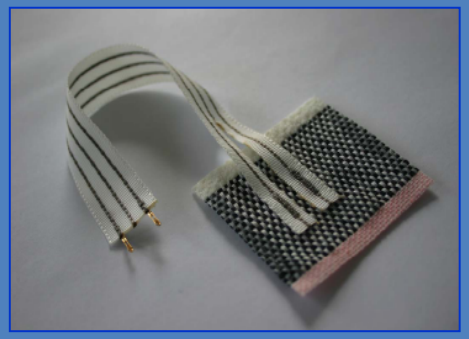


- Dispersion of nanofillers
- Characterization of physico-chemical properties of polymers
- Thermal and rheological behavior

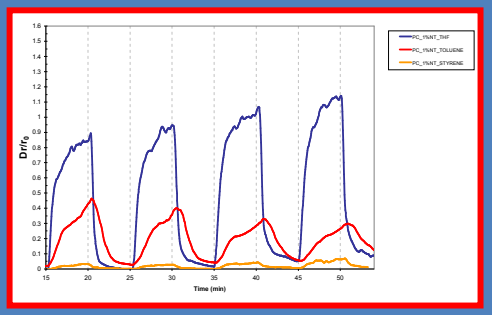
Antibacterial, fire retardant and electrical conductivity properties



Development of functional fibres



Thermal sensors

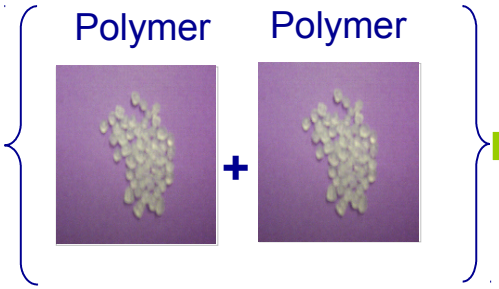


Chemical sensors

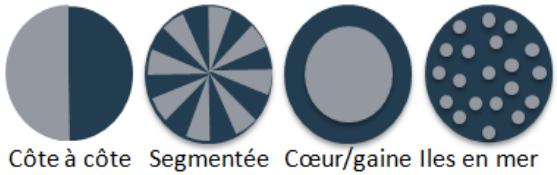
Mechanical sensors

Development of functional fibres

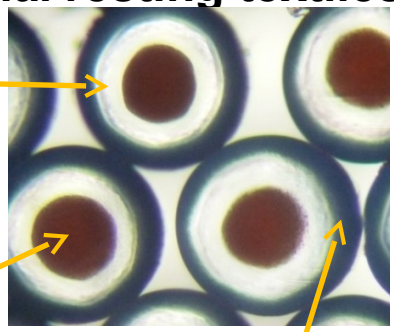
Formulation of mixed immiscible polymers for defined morphologies



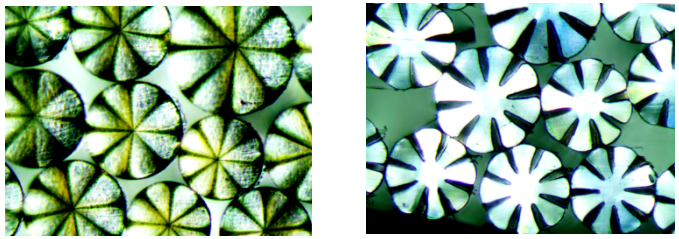
Tricomponent Melt Spinning



Development of tricomponent piezoelectric polymer fibers for energy harvesting textiles

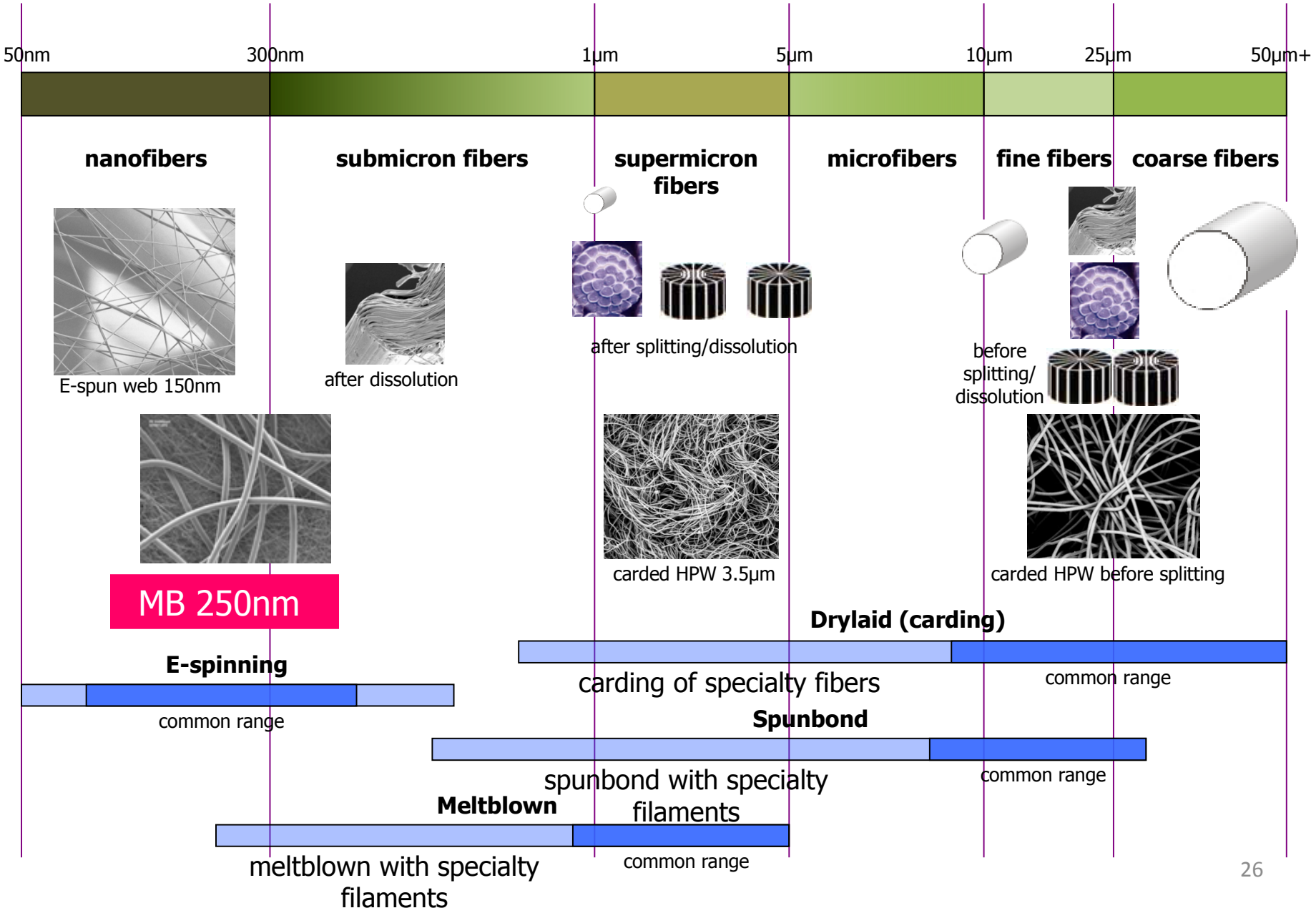


Nanofibres



Ultra fine fibre for air filtration

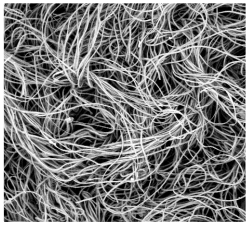
Development of textile with controlled structure

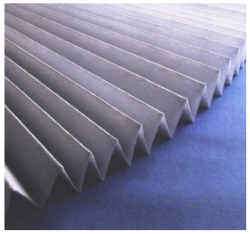


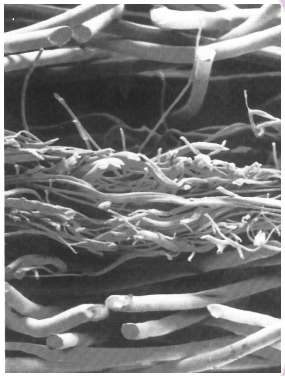
Development of textile with controlled structure

Advanced Nonwoven Materials
design, development and production support tools

Filtration & Separation





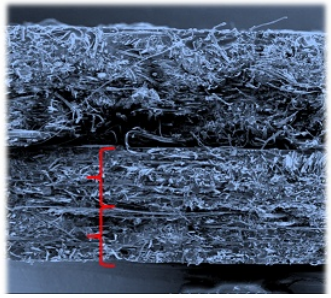


Biocomposites

MEB d'un composite ref DA3

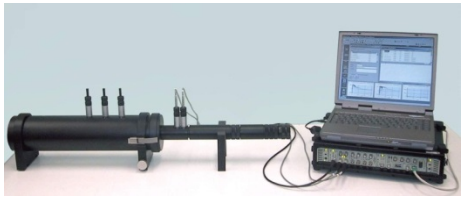
Observation des 2 profils de rupture du composite

composées de 2 couches de NT distinctes



Acoustic and Thermal insulation

Absorption acoustique (bruits aériens et solidiens), isolation thermique



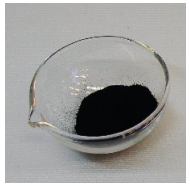
Liquid Management (capillarity, …)

Absorption, release, diffusion, …

Functionalization of textile surface

Instrumentation of parachute to monitor inflation → elongation piezoresistive sensor
(change of electrical conductivity)

Carbon black

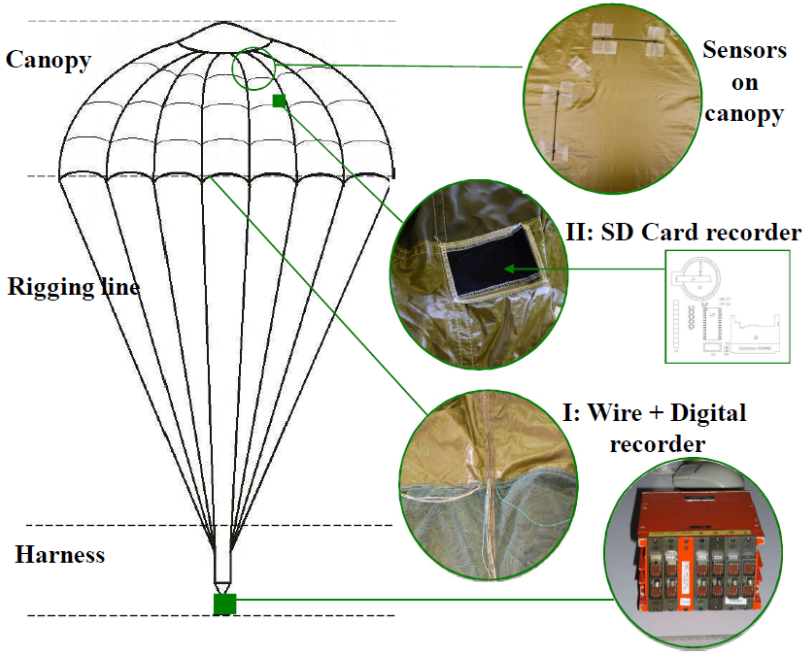


+

Thermoplastic elastomer

Conductive polymer composite by solvent process

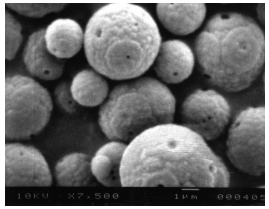
Sensor on polyamide 66 fabric



Elaboration by **solvent deposition** of conductive track whose electrical conductivity varies with external stress.

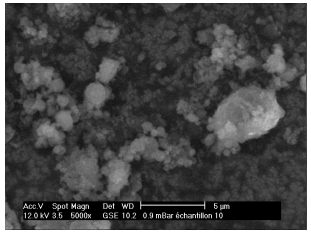
Functionalization of textiles surfaces

Development of nano/micro capsules

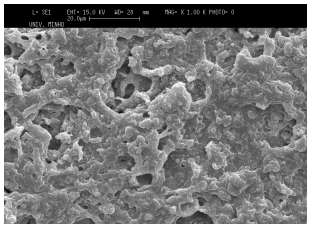


Polymerization *in situ*

Complex Coacervation

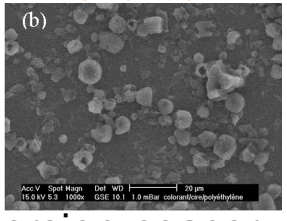


Emulsion-diffusion

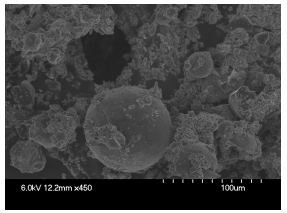


Coacervation

Cire-polyéthylène

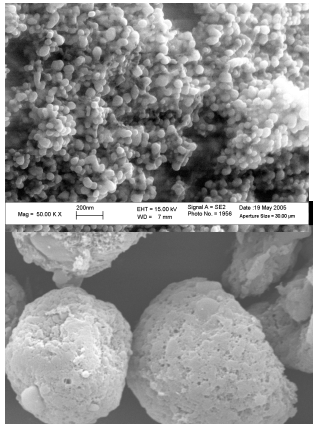


Dispersion-coacervation

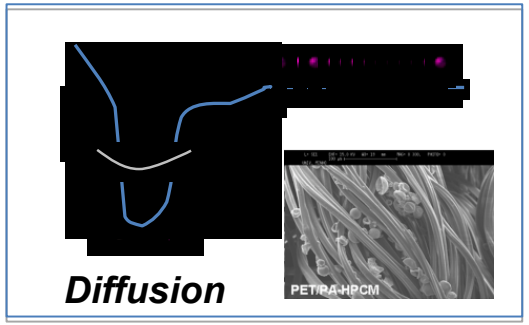


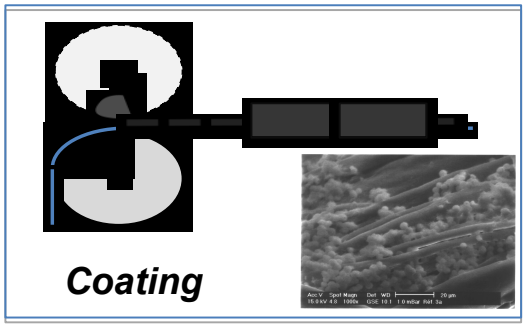
Sol-gel

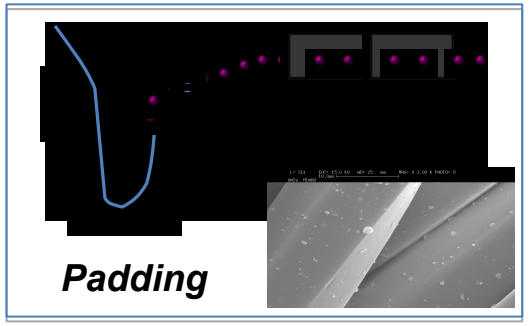
Poly(urée-uréthane)

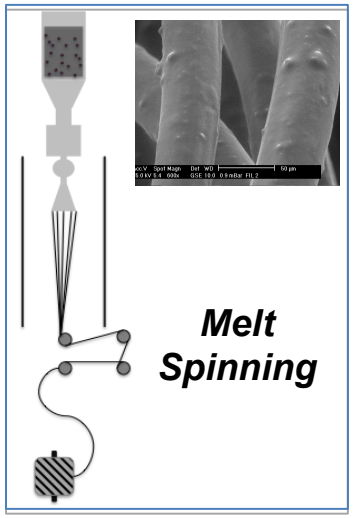


Interfacial polymerization





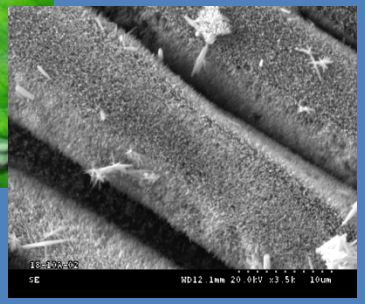


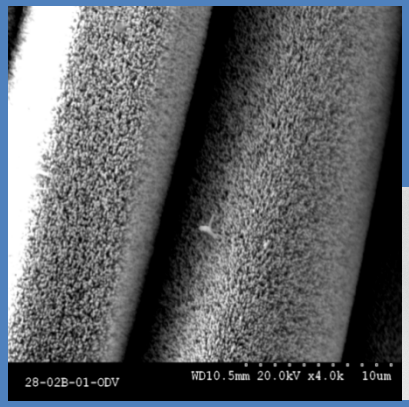


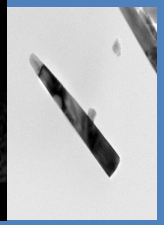
Fonctionalization of textile surface

Growth of nanorods on textile surfaces

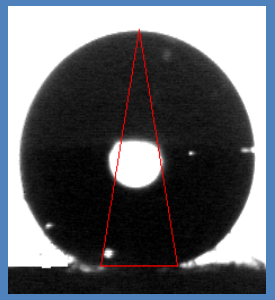
Nanorods of ZnO



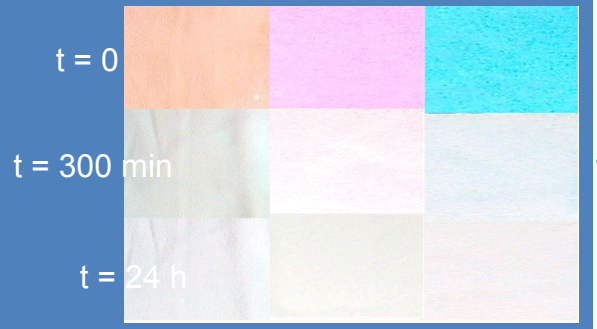


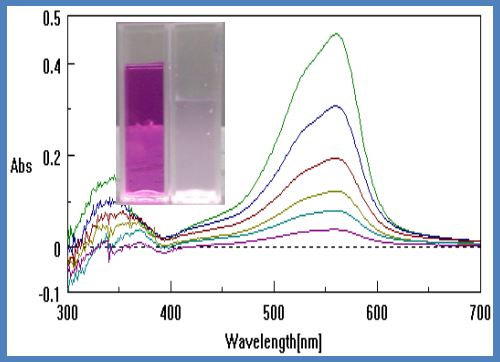


Superhydrophobic effect

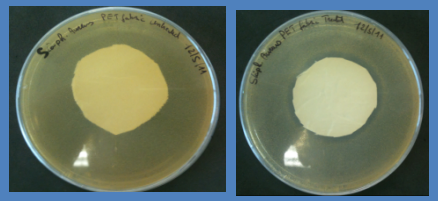


Sel cleaning property





Antibacterial properties

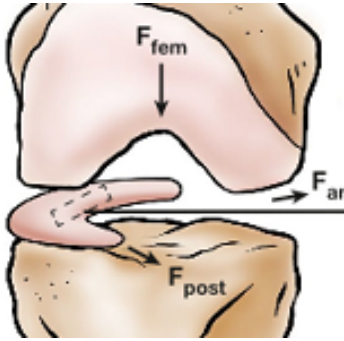


Textile Scaffolds for Tissue Engineering

BONE ENGINEERING

KNEE MENISCUS
(cartilage)

Complex multilayered 3D textile architectures for Meniscus Tissue Engineering



1. Development of nanostructrured biodegradable filaments by spinning to improve cell adhesion

2. 2D/3D textile structure with controlled porosity and pore size (cell and biological fluid)

3. Fiber surface functionalisation

COLLABORATION

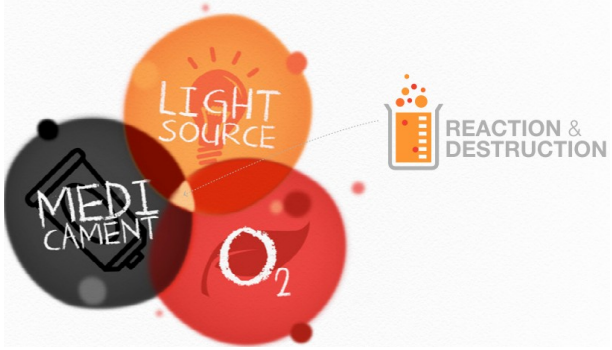
INSERM U1008 "Médicaments et Biomatériaux à Libération Contrôlée" – Fac. Médecine LOOS

INSERM, UMR 1109, Osteoarticular and Dental Regenerative Nanomedicine Laboratory, FMTS, Faculté de Médecine, Strasbourg

Development of textile with controlled structure

Flexible textile light diffuser for photodynamic therapy (PDT)

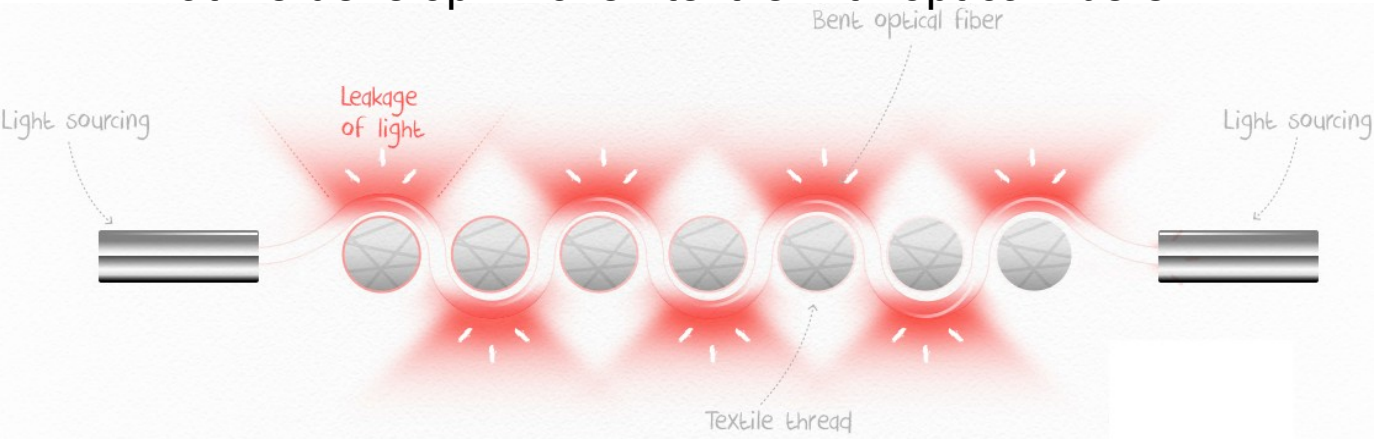
Main mechanism of PDT :



Actual system

Homogenous light distribution and flexibility

What we develop : woven textile with optical fibers



Transversal theme: Sustainable Textiles

→ Ressources:

Renewable based materials : Flax, PLA, biosourced dyes and additives

→ Process :

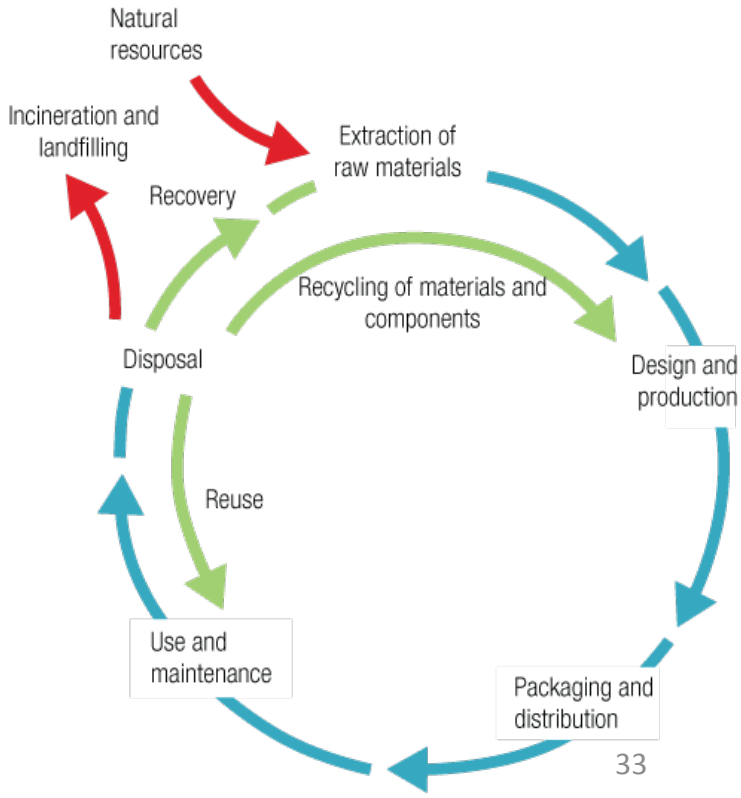
environmental friendly process : water, energy, hazardous molecules
(→ finishing)

→ Material Recycling : polymer or fiber,

→ Green supply chain:

→ Life Cycle Thinking :

LCA on products, process, supply chain, new business model



Main LCA Collaboratives Projets

- **IMPROTEX** 2009 (EC environment) **- Environmental IMprovement of PROducts,** *BIOIS*

- **ACVTex :** 2008 -2012(INTERREG IV) *UITNord, Celabor, Fedustria*
  - Chemical database
  - LCA of thextile products and process in SME– Nord France/Wallonie
  - Best Available Technologies

- **SMDtex :** 2013-2019(Erasmus Mundus): **Sustainable Management and Design in Textiles**
  - Risk/safety and resilience in the textile value chain
  - New organisation models for sustainable textile processes and supply chain
  - Sustainability policies and sustainable consumption around the textile supply chain
  - Sustainable and innovative design processes and materials
  - Sustainable quality inspection and management in the textile supply chain
  - Personalised and virtual reality-assisted textile design

- **ECLin :** 2016 – 2019 (Région Nord Pas de Calais/ ECOTLC)
  - Designing the Textile for Circular Economy – application to linen textile products