# **Specialty textile products**





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# Introduction



The vast field of specialty textile products includes solutions developed in order to meet a highly differentiated range of specific requirements. Depending on the level of integration into the fabric platform, specialty functionalities may be tailored with high precision and can be obtained through intrinsic and extrinsic modifications to textile substrates, or can be imparted through specific textile constructions or weaving techniques.

#### Keywords

connected textiles, smart textiles, interaction, interactive textiles, integrated technologies, advanced functionalities, caring textiles, curing textiles, body monitoring

# Goals

The OER aims are to provide students knowledge about advanced textile products featuring specialty properties and functionalities and their application potential.

#### Structure of the OER

- 1. Specialty textile products: empower
- 2. Specialty textile products: connect
- 3. Specialty textile products: shape



# 1. Empower

Empowered and empowering textile products are textiles that exhibit specialty functionalities imparted through the use of specialty fibers, yarns, layers, treatments, coatings, and manufacturing technologies. Depending on the fabric type and on the desired function, specialty properties can be imparted by means of intrinsic and extrinsic modifications of the selected textile substrates, and a variety of textile types may be functionalized after the basic weaving and knitting processes that have taken place. This family of fabrics includes protective textiles, recovery-enhancing textiles, cosmetotextiles and textiles with microencapsulated ingredients (e.g. insect-repellent textiles, etc.), that are gradually released when the garments are worn.





### case study: Purissimo by Devan

Purissimo by Devan is a revolutionary technology based on 100% natural probiotics that, when applied to textiles, significantly reduces the amount of pet allergens present in these textiles. Probiotic bacteria are encapsulated into microcapsules, which can then be applied onto textiles via padding, spraying and exhaustion in the presence of a specific binder. There is increasing evidence that the frequency of allergic diseases has increased world-wide over the past few decades. The major indoor allergens are house-dust mites and animal dander. Purissimo is the first textile treatment that provides a natural, environmental-friendly solution to reduce the amount of pet allergens present on textiles. It has a gradual release and long lasting effect, is wash durable and has a life expectancy of 8+ years. Applications include: bed linens, commercial furniture, home textiles, upholstery, carpets, curtains, pet blankets, car blankets, apparel, etc.



Sample/ Identification	Sample no.	Feld d1 start	Feld d1 after 14 days	Reduction [%]
Cat (F.domesticus) hair 180206-07	кı	236 mg cat hair = 20,5 µg Fel d1	15,4 µg Fel d1	0
Purissimo Probiotics + Cat (F. domesticus) hair 180206-07	К2	236 mg cat hair = 20,5 µg Fel d1	1,1 µg Fel d1	92,8
Dog (C. familiaris) hair 180206-07	кı	236 mg dog hair = 20,5 µg Can f 1	14,4 µg Can f 1	0
Purissimo Probiotics & Dog (C. familiaris) hair 180206-07	К2	236 mg dog hair = 20,5 µg Can f 1	4,8 µg Can f 1	66.7





# case study: Purissimo by Devan

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Inactive probiotics are encapsulated and integrated in the textiles. Friction opens the microcapsules and releases the spores. The spores absorb humidity and self-activate: they are transformed into probiotic bacteria and start to consume the allergens left behind by cats and dogs, which can cause allergic reactions and asthma.



### case study: CESA<sup>™</sup> Antimosquito Masterbatch

CESA<sup>™</sup> Antimosquito Masterbatch by Avient Corporation is an alpha-cyphermethrin based antimosquito masterbatch which enables the production of highly durable and efficient mosquito nets that keep their functionality for more than five years and 30 washings. Its composition of a specially formulated carrier and functionalized additives activates the incorporated alpha-cypermethrin, which acts as a strong neurotoxic agent and attacks the mosquitoes' central nervous system – leading finally to their death. The Clariant masterbatch formulation allows the polyethylene monofilament to get drawn to orient the polyethylene molecules in a preferential direction which imparts high tenacity. Thanks to the resulting low vapor pressure of the CESA<sup>™</sup> masterbatch, only a low amount of the active agent gets to the fiber surface at room temperature. mosquitos, thus reducing the overall population.





#### case study: CESA<sup>™</sup> Antimosquito Masterbatch



During use of the net, the so called glass transition temperature causes a permanent rotation of the macromolecules, ensuring a controlled release of the insecticide, and therefore permanent, consistent protection.

Another ingredient employed is pyriproxyfen, which inhibits the ability of female mosquitos to reproduce. Any pyrethroid-resistant mosquitos that escape the effects of the alphacypermethrin will still be affected by the pyriproxyfen growth inhibitor, which limits egg laying, larval-pupal transformation, and the emergence of functioning young adult mosquitos, thus reducing the overall population.



#### case study: Nanobionic materials

Nanobionic materials by Nanobionic Group is a mineral-based and bio-ceramic coating on textiles for use in easier muscle recovery following exertion, and also to improve blood circulation. The patented coating, which is applied to apparel and home textiles, takes the body's thermal energy and turns it into far infrared (FIR) rays, which stimulate metabolism and micro-circulation and, as a result, improve athletic performance. The coating is composed of a mixture of 52 different minerals that absorb radiations in the wavelength range of 4 nm–14 nm and produce far infrared (FIR) emission levels of 99%, the highest in the industry.







Nanobionic Group www.nanobionic-group.com

#### case study: Nanobionic materials

Nanobionic® gloves have been tested on subjects with Raynaud syndrome, a disorder of the blood vessels, usually in the fingers and toes that affects 3-5% of the general population. It causes the blood vessels to narrow when subjects are cold or feeling stressed. Being extra sensitive, when the blood vessels in the hands and feet overreact to cold temperatures, they become more narrow than normal, making the hands and feet temporarily feel very cold and numb.

All subjects wearing Nanobionic® gloves reacted similarly: the 20 minute follow-up study that has been performed shows that after wearing the gloves, showed reestablishment of normal peripheral circulation in the fingers with normal temperature gradients. In summary, the findings indicate that the use of Nanobionic® gloves substantially improves the local circulation in patients affected by Reynaud disease.







after 30'



Nanobionic Group www.nanobionic-group.com

#### case study: CottonX™



CottonX<sup>™</sup> by Argaman Technologies Ltd. is a EPA approved copper functionalized cotton for applications in skincare. 100% natural cotton is fused with 0.3% copper oxide without compromising the inherent properties of cotton. Copper is not only a powerful antibacterial, sanitizing and anti-odor material, is equally important in nurturing and protecting skin appearance. Research has shown that copper plays a key role in several processes of skin formation and regeneration. When using copper-infused textiles, positive cosmetic effects are noted such as significant reduction in the appearance of wrinkles and improvement of general appearance within several weeks of use. When in contact with skin, the copper helps promote skin regeneration and collagen synthesis, resulting in smoother, firmer and healthier- looking skin. The cotton fibers are functionalized with copper using a proprietary treatment. Applications include active-wear, denim, undergarments, shape-wear, work-wear, medical textiles, towels and bedding.



copper compound bacteria

microscopic view of copper oxide on cotton fiber interacting with bacteria to prevent reproduction

Argaman Technologies Ltd. https://cottonx.co/

#### case study: CottonX<sup>™</sup>

CottonX<sup>™</sup> patented technology is an industrial method for the impregnation of cotton fibers with different particles that integrates seamlessly with the standard process of cotton spinning.

The process begins where the particles are blasted into fibers using the energy of sound waves. Cavitated bubbles collapse creating powerful shockwaves and water-jets of 400 m/s. These shockwaves accelerate the particles to high speeds, causing them to embed in the fiber. Due to this energy transfer, the particles are embedded in the fiber through its life. After this process, the cotton sliver can be spun into a yarn for weaving or knitting, as in ordinary textile manufacturing for variety of products.

The material is available as cotton sliver, cotton yarns and cotton blend yarns. It can be customized as the treatment can be applied in different staple lengths according to product needs.



Argaman Technologies Ltd. https://cottonx.co/



untreated cotton fibers: intense bacterial growth



CottonX<sup>™</sup> SKINCARE treated cotton fibers: no bacterial growth



### case study: StretchEnergy™

StretchEnergy<sup>™</sup> by Asahi Kasei Corporation is a unique patented fabric structure system that is able to generate and retain heat through continuous stretch and recovery, giving new meaning to active performance. This material is made with ROICA<sup>™</sup> premium stretch yarn and is designed to exhibit an exothermic (heat releasing) effect upon stretching. ROICA is more stretchable than rubber, with excellent recovery. It produces measurable heat up to 2 degrees (demonstrated in winter cycling tests, certified by Cerism, Outdoor Sport Research Centre at Verona University) with minimal heat loss, thereby maintaining warmth and muscle comfort performance during and post-exercise.



Asahi Kasei Corporation

www.asahi-kasei.co.jp

#### case study: StretchEnergy™



Unlike other fibers that generate heat by absorbing moisture, the ROICA fiber is causing the temperature increase due to reduced entropy as a result of the physical process of elongation and will continue to generate heat as long as it expands and contracts repeatedly. The special knit design is devised to maximize the amount of heat generated and to store it for improved performance of the user. The material is available as a fabric per meter. It is suitable for many applications, such as activewear, outdoor/climbing wear, shapewear/innerwear, hosiery, and cycling.



Asahi Kasei Corporation www.asahi-kasei.co.jp

#### case study: StretchEnergy™

The mechanism of heat generation by stretching (difference from heat generation by moisture absorption)



#### heat generation by stretching



When the ROICA fiber is stretched, entropy (molecular disorder) decreases and heat is emitted. heat generation by absorbing moisture



Sweat and other water vapor released from the body are absorbed by special fibers and heat is emitted.

Asahi Kasei Corporation www.asahi-kasei.co.jp

#### case study: ceraspace™

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ceraspace<sup>™</sup> by Schoeller Textil is a selective textile coating technology that imparts high abrasion resistance to the material's outer surface. Ceramic particulates are incorporated into a compliant polymer matrix and deposited onto through printing onto woven or knit textiles in a raised, flat head cone shape. These shapes stand proud of the fabric and create a protective grid that has been designed to resist abrasion from scraping, abrasion and blunt cutting such as might be expected to occur on a fall from a motorcycle at speed. The fabrics when tested in a crash simulation and performed significantly better than high quality leather, withstanding several crashes at 120 km/h.



Schoeller Textil AG www.schoeller-textiles.com

#### case study: ceraspace™

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The printed fabrics are also an effective heat barrier (such as when high friction sliding is involved), because the ceramic loaded cones are heat resistant and also create an air space between the fabric and the hot surface. The fabrics are offered in a range of deniers and yarn types including polyester, nylon, Kevlar® and other high performance materials. It exhibits high washing and dry cleaning permanence, as well as good weather and UV resistance. Applications are for extreme sports apparel, military apparel, footwear and motorcycling outerwear. When standard textiles are exposed to high temperatures, they become damaged. The 3-dimensional coating is highly resistant to elevated temperatures and works as a protective space barrier between the textile and a heat source. Thanks to the duroplastic properties of the polymer, no melting is possible and the heat-up rate remains low, minimizing the possibility of exposure to harmful heat and abrasion for the wearer.



Schoeller Textil AG www.schoeller-textiles.com

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Contact heat properties: Test samples with identic weight, > 550 °C (Approx 1020 °F) contact heat.



Leather: gets hard, splits and shrinks obivously.



ceraspace<sup>™</sup>: only slight damage of the 3-dimensional coating. No shrinking.

Schoeller Textil AG www.schoeller-textiles.com

#### 2. Connect



Seamlessly integrated components include printed and flexible sensors, conductive yarns, flexible, printed and thin film batteries, flexible displays, textile buttons, keypads and keyboards.





# case study: LOOMIA Electronic Layer (LEL)

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The LEL (LOOMIA electronic layer) is a soft, flexible circuit that is mechanically different from a traditional PCB, making it useful for textile-based products.

This highly conformable, sewable and bondable smart textile layer can be integrated into products to provide heating, lighting, and sensing functionalities. It is a thin material consisting of polyester and a combination of metals. It is soft, flexible (bend radius < 1 mm (0.04 in) without holding crease), drapeable, and suitable for apparel or other textiles with a fabric-like quality. It eliminates the use of wires for electronic textiles. Based on the specific need, it can also come in stretchable, machine-washable, and dry clean safe options. The heating LEL system with two off-the-shelf power bank options and its adaptor cable have been FCC certified, and the multi-purpose adaptor cable has been FCC & CE certified (certificates are available upon request).



### case study: ZSK Technical Embroidery Systems

Technical Embroidery for E-Textiles developed by ZSK Stickmaschinen GmbH is a specialty embroidery technique that enables to embed electronics and their electrical properties into fabrics, allowing for a new class of self-aware materials.

A keyboard produced by this company's technical embroidery machine to automatically connect a circuit board to a piece of fabric and to use that same conductive thread to create capacitive touch sensors. The keyboard is made on black twill cotton cloth with colored polyester thread, and special silver coated nylon conductive thread.



**ZSK Stickmaschinen GmbH** www.technical-embroidery.com



# case study: ZSK Technical Embroidery Systems

The company's technical embroidery machine stitches the circuit board directly to the carrier cloth using conductive thread. This thread not only serves to connect the board to the cloth but is also used to create the capacitive touch sensors functionalizing the embroidery. Special functionalized electronic sequins can be used to further add LED's or sensors in the embroidery process. Visual and technical design possibilities are endless. Moss embroidery has increasingly been used as a method of collecting biomedical signals from patients. Its versatility and use for eclectic signal types and biometrics has further inspired interest in the technology. Additionally, due to its low cost, high customization, and automatic embroidered production, moss electrodes are increasingly relevant in biometric signal collection.



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**ZSK Stickmaschinen GmbH** www.technical-embroidery.com

# 3. Shape



Textiles featuring specific threedimensional surfaces and structures are suitable for applications related to the fields of fashion and accessories, but also interior/exterior design and architecture.

The structures may directly be created through specialty weaving or knitting processes, or obtained by means of re-elaboration of existing woven or knitted textiles, or non-wovens and coated textiles.

Achievable options include creating geometrically pliable and foldable textile products, as well as imparting 3d-ization properties to originally flat, seamless and fully flexible and drapeable textiles, in order to allow a certain shapeability and form protective or more wear resistant areas within the garment, accessory or upholstery piece.



#### case study: GRDXKN®

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GRDXKN® by Bastian Müller is a selective three-dimensional printing process for textiles. This structure printing technology has been developed for textile products and is used to transform a two-dimensional fabric into a three-dimensional structure. The print creates a unique patterned appearance, while providing a combination of rigidity and flexibility where needed. The technique is comparable with traditional screen printing, but instead uses a proprietary formulation of technical paste as the ink. This paste is water based and solvent-free. After drying, the print is thermally activated to affix the design.



Bastian Müller GRDXKN http://grdxkn.com/

### case study: Acoustic Architectural Textiles

A range of architectural textiles inspired by traditional Japanese origami, translated into digital parametric weaving techniques to create flexible and adaptive structures for interiors. They can be used as spatial installations, wall panels or curtains to improve acoustics, climate regulation, energy efficiency and the flexibility and experience of the space. Multiple material variations are possible within each product category based on Trevira CS, paper, elastics, acryl, mohair, paper, and cotton blends. The innovative weaving process enables the material to fold itself into structural 3D surfaces.





**Studio Samira Boon** https://samiraboon.com/



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