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High performance textiles

The “texturgy” as a new approach for the industry of textile materials

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Challenges of new materials are well-characterized by the industries which maintain a global leadership (energy, ICT, health, quality of life, protection /safety). Manufacturers try to make the most with intrinsic properties of materials, considering manufacturing process. Every player seeks to optimize material utilization whence materials are ever more complex, and merge into each other.

Supra-textiles

As it happens, “supra-textiles” (adaptive textiles, high-performance materials with physicochemical and dynamic properties, bio-inspired and bioactive materials) are bursting into the area of advanced technologies and they stretch the technical or sustainable boundaries of actual solutions. So, textile materials played a central role and are nowadays of high relevance to all important industrial sectors. Modern textiles and related materials (including nonwovens and composites) combine numerous structures and functions, and are integrated in ever more complex multi-functional systems. An eclectic approach for textiles development necessarily encompasses new technologies and biology because these textile systems are able to fit in other materials and communicate with its environment.

Multidisciplinary and integrative methodology

New textile systems highlight the emergence of a new paradigm for technological research and development which requires a multidisciplinary and integrative methodology (chemistry in a state, new processing, biology, physics). This cross-disciplinary theme between new technologies and new materials is of high relevance in the international competition. This paradigm shift has already started, for example in the design and optimization of carbon fiber reinforced polymers. Engineers must take integrate the orientation of the microscopic carbon fiber in the design of larger structures, ensuring that the local orientations of the fibers are optimum with respect to the geometry of the structure and the stresses it carries.

Textile potential in a state

Nonwovens allow to design a very large number of textile structures (veils, mats, consolidation), and create even more possible opportunities with various combinations of fibers. The reinforced composites industry is inheritor of textile industry. Manufacturers play around with the texture and the geometry of textile reinforcements (woven, braided, knitted, stitched) in order to create a fitted and tailored to needs architecture. Nonlinear multi-scale modeling technology enables to predict the behavior of a composite based on the performance of its constituents (matrix/fibers) and on the underlying microstructure (fiber

content, length, orientation) as dictated by the manufacturing process. Automated fiber placement (AFP) machines increase rate and precision in the production of advanced composite parts.

Markets are divided on the basis of end-user industry, but materials are made by intermediate goods industries such as metallurgy, plasturgy, chemistry, ... or texturgy. The future belongs to flexible and versatile materials like textile which is a catalyst for cross-sector technology innovation. New textile materials are not today a simple alternative to usual materials but a real high-tech component which plays a key role in the field of advanced technologies. Textile sector takes advantage of new opportunities in the vibrant industry of composite materials. It needs a clear vision of “texturgy” as the industry of new textile materials through a thorough scientific, technical, sociological and economic analysis.

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Figure 1

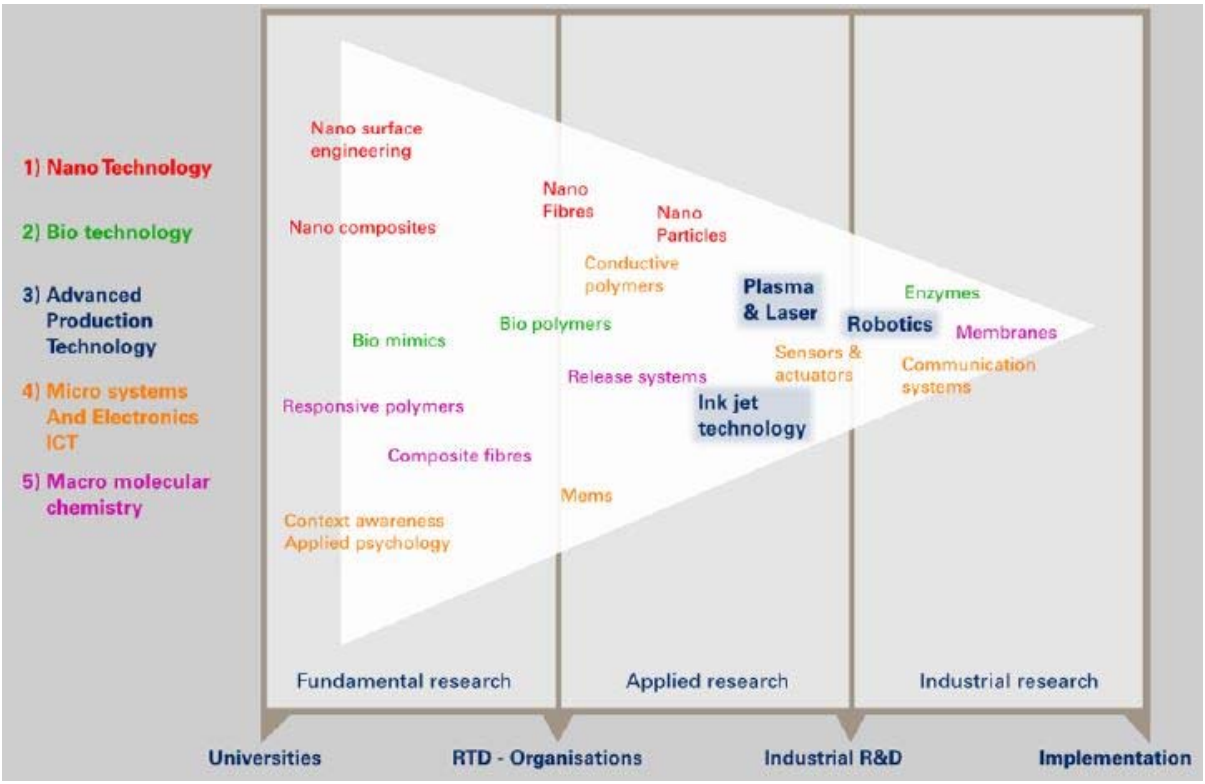

Figure 2

Figure 2 – Technology thrusts in each of the key challenge areas

	Energy	Sustainability	High Value Markets
Lightweight materials and structures, including composites and hybrids	x	x	x
Materials to withstand more aggressive environments (e.g. high temperature, corrosive, erosive)	x	x	x
Electronic and optical functional materials	x		x
Smart and multifunctional materials, devices and structures	x	x	x
Surface engineering and coating technologies	x	x	x
Particulate engineering; near-net shape manufacturing	x	x	
Fibre and textile-based technologies	x		x
Bioresorbable, bioactive and biocompatible materials			x
Natural and bio-based materials		x	x
Joining technologies	x	x	x
Materials for portable power sources (batteries/fuel cells)	x		x
Nanomaterials	x	x	x
Materials with reduced environmental impact through life		x	
Materials designed for reuse/recycle/remanufacture		x	
NDE/SHM/condition monitoring	x	x	x
Predictive modelling through the full life cycle, including lifetime prediction	x	x	x