

## **Smart by Design and Intelligent by Architecture Nanocomposites Materials: The SMARTFAN project**

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Smart materials (smart structural systems) exhibit ability to sense their environment in the form of external stimuli and the effects thereof and, to respond via an active control mechanism. These materials are the key to 21<sup>st</sup> century competitive advantage through the development of products with multiple levels of functionality [1]. In addition, digitalisation is a global trend of major transformative character, comprising all areas of daily and professional life. Businesses, consumers and industry are increasingly using digital technology to grow, overhaul workflows, generate efficiencies and develop new products and services. As Internet of Things (IoT) is primarily driven by knowledge and know-how, it presents a huge opportunity to build on Europe's strengths and compete in the market [2]. As such, digitisation, and accompanying social and economic policies, can become an opportunity for Europe to be established as a global leader with main hub for expertise, while sustaining and improving its societal and economic model [3].

The development of smart (bulk) materials is a novel concept that SMARTFAN project is dealing with, through micro and nano components, for final application on intelligent structures with integrated functionalities that are able to communicate and interact with their environment (upon IoT and in line with Industry 4.0), store data about their condition and, based on external stimuli, react accordingly; at the same time, real-time monitoring of processes and materials performance are foreseen. The cases include carbon fibers (CFs) for reinforcement and conductivity variance, carbon nanotubes (CNTs) and carbon nanofibers (CNFs) for sensing, micro-containers for self-healing, nanoparticles for electromagnetic fields detection and shielding, colouring agents for marking cracks and defects, and piezoelectric materials. In order to develop lightweight composite materials and transfer the properties of smart components into bulk materials, polymer based matrices (such as epoxy resins, polypropylene, polylactic acid, etc.) are used, due to their compatibility with the above mentioned components, their low cost and in case of thermoplastics their recyclability/reusability.

Using CF reinforced plastics as primary materials, intelligent structures are approached through two different design concepts, L concept based on multilayer architecture of composite materials and G concept that focuses on composite architectures including variable fibre grids. The composite material (layers and grids) architectures will be the crucial parameter for dealing with Smart-by-Design intelligent structures that leads to reduction of environmental impact (reuse/recycling of materials at their End-of-Life).

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### **References**

- [1] Smart Materials for the 21st Century, Foresight Smart Materials Taskforce, Report no. FMP/03/04/IOM3, Institute of Materials, Minerals and Mining, London, 2003.
- [2] LAB – FAB – APP: Investing in the European future we want, Report of the independent High Level Group on maximising the impact of EU Research & Innovation Programmes, Brussels, July 2017.
- [3] RE-FINDING INDUSTRY: Report from the High-Level Strategy Group on Industrial Technologies, European Commission, DG Research & Innovation, Brussels, February 2018.