

## 1. Nanocons (Development of nanostructured coatings and materials for the construction sector)

- **Description:** To be able to have an adequate building infrastructures fabric that bears in mind both the present and future needs of today's society and economy, buildings for both housing and services must be appropriately designed and efficiently constructed. In this regard, and following the lines drawn up by the European Platform on Construction Technologies, the construction material and derived constructive systems must satisfy several parameters such as: high durability and deterioration resistance, good mechanical performance, adequate cost-profit ratio, easy installation and low maintenance margin throughout their working lives.

Since far-off times until today the main construction elements used by traditional construction have been stone, wood, reinforced concrete and steel. All these materials have adequately satisfied their functions but they also have disadvantages under certain conditions. This is the case of wood, which requires large investments in maintenance, or reinforced concrete that has a high density and demands great handling and installation capacity, or steel that poses corrosion problems ...

With this perspective, the possibility of developing new materials for construction, a sector that has large production, transport, installation and maintenance volumes, which will have better properties and new service characteristics, gives rise to both performance advantages (mechanical properties, deterioration resistance, reduced weight, etc.) and economic advantages, as less resources (manpower, equipment, vehicles, etc.) are required to handle them. In this sense, one of the most interesting developments from the technological viewpoint are nanostructured materials.

Nanostructured materials refer to materials or components that are made up of nanocrystalline or quasi-nanocrystalline grains or particles. This type of material usually has much greater mechanical (static and dynamic) properties as well as magnetic, tribological and degradation resistant properties. Nanostructured materials represent the application of nanotechnologies in the field of materials science and engineering and will have a great impact on several economic sectors such as biomedicine, electronics, transport, the environment and, of course, construction.

There are two technological categories for producing nanostructured materials: descending and ascending. In the former, the nanostructured material is formed by directly processing a microstructured material; in the latter, the nanostructured material is obtained by assembling molecules and/or atoms. Nowadays, the most popular and economical methods include pulvimetallurgy, amorphous melt and severe plastic deformation, the latter being the simplest method with the best value for money, thanks to the processing conditions and manufacturing tools.

Metal alloys with an ultra-fine grain size (at submicrometric and/or nanometric scale) permit designing and processing components that require less material and fewer manufacturing steps, all of which results in energy and economic savings. This is due to the fact that these nanostructured materials show greater mechanical resistance, high tenacity and better fatigue resistant properties. Furthermore, they can behave super-plastically at relatively low temperatures ( $< 0.5 T_m$ ) and at high deformation speeds. Nonetheless, in the case of light metal alloys (e.g. aluminium, magnesium, and titanium) it is possible to design components with high specific properties, a very important feature for transport applications and some construction applications.

With a view to executing significant innovations in this materials field, specifically in the construction sector, it is necessary to do research in their development and characterisation.

- **Participants:**

- University Groups: 3. Public University of Navarra. (Group of Nanostructure Mechanisms, Multidisciplinary Group in Nanotechnology, Group of Materials Engineering and Manufacturing).

- Technological Centres: 2 Association of Navarra Industry and L'Urederra Foundation.

- Companies: 2. AH Asociados Arquitectos S.L (leader), Simes Senco, S.A.

- TOTAL: 7

- **Project Time:** 01/09/2007 until 30/08/2010

- **Total Budget:** 1,644,450 €

## NANOTECHNOLOGY

### 2. Nanofillers (development of innovative functionalised nanofillers to incorporate into plastic moulding dies)

- **Description:**

Classical developments based on polymeric nanocomposites focus on obtaining the maximum profit from the intrinsic properties of mineral fillers used in these composites, as for example, the use of laminar silicates as a mechanical property reinforcement or carbon nanotubes to improve the electric-conductivity properties of plastic moulds. These properties are generated from the maximum dispersion of the mineral fillers at nanometric scale in the polymeric mould.

In this regard, the NANOFILLERS project, framed within the EUROINNOVA initiative, is based on incorporating specific properties (custom-designed depending on the technical requirements of the final applications) into the different mineral nanofillers used, thus combining the intrinsic properties of these mineral fillers with the specifically designed functionalities for each final application.

The developments obtained in the Nanofiller project will be shown via the production and testing of extremely innovative nanocomposites with different functionalities as mentioned below:

- a) Functionalised nanofillers with integrated light absorption activity.
- b) Functionalised nanofillers with an increased reinforcement capacity, permitting a substantial improvement in mechanical and fire-resistant properties in plastic moulds.
- c) Functionalised nanofillers for use as a nanocatalyst in certain ageing processes.

- **Participants:**

- University Groups: 1. Public University of Navarra. (Group of Applied Chemistry).

- Technological Centres: 1. L'Urederra Foundation (leader).

- Companies: 3. AH Asociados Arquitectos S.L., Simes Senco, S.A, and Compuestos y Granza, S.A.

- TOTAL: 5

- **Project Time:** 01/09/2007 until 30/08/2010

- **Total Budget:** 1,179,760 €

### **3. Inkjet deposition of functional materials.**

- **Description:**

The project aim is to develop digital material deposition technologies as an alternative manufacturing process. In order to implement this technology within a production process, the materials must be developed appropriately in order to adapt them both to the product to be manufactured and to the deposition process. The applications that benefit more directly from these new manufacturing processes are those related to the development of electronic product, due to the important turnaround that is being seen in the market orientation towards high performance products.

In the regional field, the aim is to integrate the efforts of technological centres, university groups and companies of the printed electronics sector to introduce the technology of digital Inkjet deposition of custom-made materials. These materials give rise to improvements in both the durability of the product as well as in its application range. With nanotechnology, the materials currently used to manufacture printed electronics (noble metals and oxides) can be extended to inkjet applications, simplifying the process and reducing waste.

The digital manufacturing process, on the other hand, permits improving the competitiveness of short series, as it is a non-contact procedure and does not use intermediate tools. An appropriate scenario is created around this technology to consolidate high technological innovation companies that provide the sector with support and service.

The consortium is comprised of the companies EMBEGA S. COOP., PIHER-NACESA S.A., L'Urederra Foundation, CEMITEC and GM-UPNA. 50% of the participating companies come from the electronic product sector,

thus converting this proposal into a strong bid by the sector for radical innovation in its production processes.

- **Participants:**

- University Groups: 1. Public University of Navarra. (Multidisciplinary Group).

- Technological Centres and Foundations: 2. Multidisciplinary Centre for Innovation and Technology of Navarra of the Cetena Foundation (CEMITEC) (leader), and L´Urederra Foundation

- Companies: 2. Embega S.C.I. and Piher Nacesa.

- TOTAL: 5

- **Project Time:** 01/09/2007 until 31/12/2009

- **Total Budget:** 1,414,500 €

## NANOTECHNOLOGY

### 4. Nanosens. (Development of new multi-application sensors).

- **Description:** The objective of the project is to adapt sensors, via the use of different nanotechnologies, whose use may provide a **considerable technological and competitive advantage** to companies of the sectors where they are going to be applied: Construction, Agronomics, Agrofood and Pharmacy. More specifically:

In connection with the **Construction sector**, represented by the company ALONSO HERNÁNDEZ & ASOCIADOS ARQUITECTOS, S.L., the nanosensors developed will be able to monitor and inspect the service variables of buildings: temperatures, humidity, chemical and biological species that may be harmful both for users in the habitation phase and for workers in the execution phase, presence detection, structural element deformation measurement and control of service variables. The nanoantenna and microthread technologies will be used

In connection with the **Agrofood sector**, represented by the companies EMBUTIDOS GOIKOA S.L., INDUSTRIAS CÁRNICAS NAVARRAS, PAMPLONICA S.L., the objective of the project is to develop nanosensors that will improve both the process safety via the control of parameters such as humidity, temperature, metabolites, product composition modifications and the quality of the actual products throughout the manufacturing and distribution chain. The following technologies will be applied: nanoantenna, macromolecules of biological origin, electrostatic deposition of self-assembly layers and nanoclays.

**In Agronomics**, a sector represented by the companies TÉCNICAS Y PROCESOS AGRÍCOLAS S.L. and SIMES SENCO, nanosensors will be developed that can be incorporated into the actual cultivation areas and that will provide information about the actual plant: microclimatic conditions, humidity, nutrient content, presence of plagues, growth of these

plants. The following technologies will be applied: nanoantennas, microthreads, macromolecules of biological origin, electrostatic deposition of self-assembly layers and nanoclays.

In connection with the **Sports Medicine and Pharmaceutical** sector, the objective is to develop a commercial device that can be used in sports clubs, pharmacies and hospitals that will be able to monitor human breathing in non-forced effort tests. The following technologies will be applied: macromolecules of biological source, electrostatic deposition of self-assembly layers and nanoclays.

Each one of the aforementioned applications gives rise to a work package, coordinated by the Group responsible for its scientific and technological development.

Parallel to this and throughout the entire duration of the project, a horizontal task will also be developed, coordinated by AIN and whose objectives will be to **industrialise** the solutions that are developed in the different application packages.

- **Participants:**

- University Groups: 4. Public University of Navarra. (Group for the development of nanoantenna-based multifunction nanosensors, Group of thread and microthread based multifunctional nanosensors, Group for the development of multifunctional nanosensors based on the use of macromolecules, Group for the development of multifunctional nanosensors based on the use of ESA technology).

- Technological Centres and Foundations: 4. Association of Navarra Industry (leader), CEMITEC, CNTA (National Centre for Food Safety and Technology) and L'Urederra Foundation.

- Companies: 8. Alonso Hernandez & Asociados Arquitectos S.L, Embutidos Goikoa s.a., Industrias Cárnicas Navarras, S.A., Incanasa Argal, Pamplonica S.L, Simes Senco S.A., Técnicas y procesos agrícolas S.L and Laboratorios Cinfa S.A.

-TOTAL: 16

- **Project Time:** 01/09/2007 until 30/09/2010
- **Total Budget:** 3,272,700 €