

SAPHIR – EUROPEAN PROJECT

Safe, integrated and controlled production of high-tech multifunctional materials and their recycling

Dr Frederic SCHUSTER, CEA
Christophe GOEPFERT, CILAS

GENERAL OVERVIEW

Industrial needs in terms of multifunctional components are increasing. Several sectors are concerned, ranging from mature high volume markets like automotive applications, high added value parts like space & aeronautic components or even emerging activities like new technologies for energy. Nanotechnologies could play a key role in promoting innovation in design and realisation of multifunctional products for the future, either by improving usual products or by creating new functions and new products. Nevertheless, this huge evolution of the industry of materials can only happen if the main technological and economic challenges are solved with reference to societal acceptance. It concerns the mastering, over the whole life cycle of the products, of the potential risks, by an integration of the elaboration channels, while taking recycling into account.

OBJECTIVES-GOAL OF THE WORK

The SAPHIR project (funded by the European Commission) aims at:

- Implementing direct production of nanoparticles through the development of a global integrated concept (from the synthesis to the final products as shown in fig. 1) with a responsible approach. Indeed, the main breakthrough is to connect individual processes so that the handling of the produced powders is avoided. By means of safe recovery and conditioning systems, such as suspensions or nanostructured granulates, nanoparticles can be manipulated without risk.
- Manufacturing by emerging combinations which will allow the elaboration of new generation of metallic matrix composites (MMC), ductile ceramics and ceramic matrix composites (CMC), polymer matrix composites (PMC) for bulk applications in the field of aerospace or energy and for surface engineering in the field of building applications.

SIGNIFICANT NEW ACCOMPLISHMENTS

After the third year, the SAPHIR project now shows clearly a large number of very valuable results in 3 main domains which are:

- The manufacturing of high performance **raw material** like ODS nanostructured powders, nanosized ZnO particles (see fig. 2) or Al/nano SiC nanostructured powders.
- The safe oriented **processes** which avoid any contacts with workers. Indeed, some developments have been achieved in the manufacturing process itself which is the granulation of the nanopowders (see fig. 3) in order to guarantee no release of nanoparticles at all in the air. The safe recovery system (see fig. 4) has been successfully tested in the phase vapour synthesis application and different forms of paste have been tested for the collection of particles. Significant progress has also been made in the field of the monitoring of processes with, in particular, windows monitoring (see fig. 5) coupling LIBS (Laser Induced Breakdown Spectroscopy) technology to the unit of nanopowder synthesis at CEA Saclay. Some very encouraging first results have also been obtained on RFPM (Radio Frequency Plasma Monitoring) technology.
- **Applications** in surface engineering for example in the nanostructured coatings field for building applications, promising results of photocatalysis have been confirmed both by the sol-gel technology and the technology of suspension plasma spraying. Bulk applications have also been tested and have given good results as on bipolar plates for PEMFC using carbon nanotubes (fig. 6).

CONCLUSION-IMPACTS TO THE NANOTECHNOLOGY FIELDS

SAPHIR proposes an innovative approach based on the use of nanotechnologies, which promotes a real change on how raw materials are considered in the industrial value chain. Indeed, the subsequent integration of the safe production of nanoparticles, their recovery & conditioning and finally their processing, enable to achieve net shape products, produced directly from raw materials and able to meet very specific requirements of a given application. This approach enables to shift towards the production of high added value materials and to position the raw material producers closer to the end-user, thus improving their contribution in the value chain. Indeed this differs from conventional industries, where the added value is usually brought rather by the integration of the material in components than by the material itself.

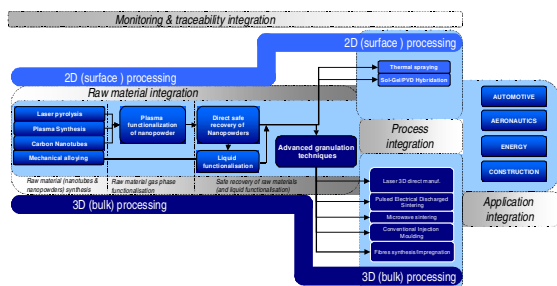


Fig 1: global integrated concept

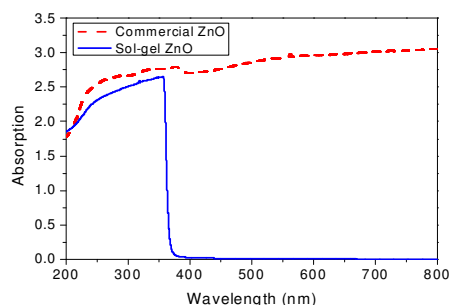


Fig 2: UV blocking capacity

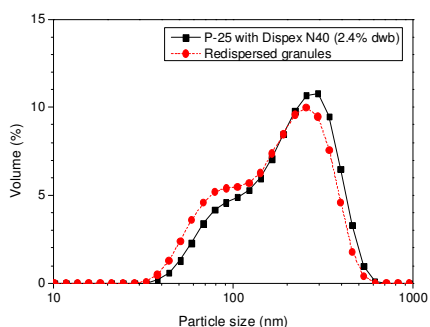


Fig 3: properties of re dispersed granules

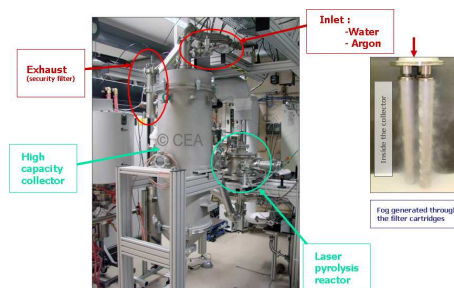


Fig 4: recovery system

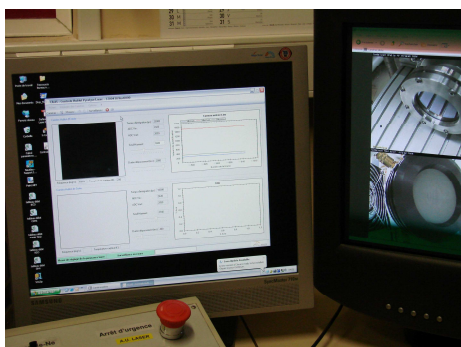


Fig 5: active detection software



Fig 6: CNT-containing bipolar plate

Christophe GOEPFERT - Vice-President Development

CILAS

8, Avenue Buffon - B.P. 6319 ZI La Source - 45063 ORLEANS Cedex France

Phone : +33 (0)2 38 64 59 21 - Fax : +33 (0)2 38 64 59 22 - goepfert@cilas.com