

## E 10: MULTIFUNCTIONAL MATERIALS FOR ADVANCED TECHNOLOGIES

### Projects and technologies

Because in the evaluated period most of beneficiaries interested in the synthesis, physical-chemical characterization and application of the organic dyes and pigments stopped their activity, arose the necessity to turn our research from conventional applications of such materials to new areas, which involved complex, multidisciplinary, and interdisciplinary researches in the field of multifunctional materials for advanced technologies like chemistry of surfaces, medicine, biotechnology, nanotechnology, environmental protection. The team activity was focused on the following three main directions/topics: (nano)materials/(nano)technologies for industrial applications, (nano)materials/(nano)technologies for textile applications, and (nano)materials / (nano)technologies for medical applications (see Fig. 1).

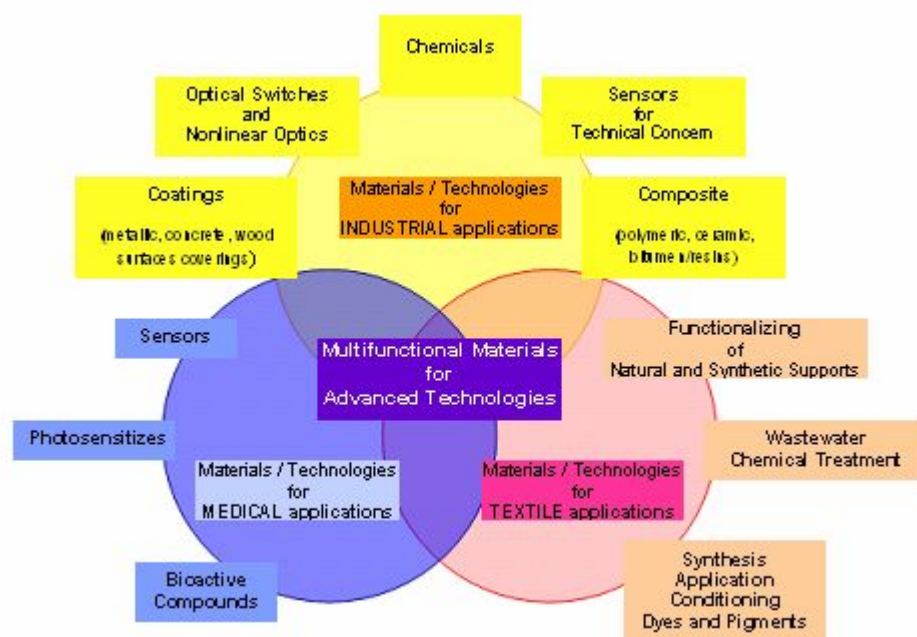


Fig. 1: Research directions

In the last 4 years the new orientation of the team mainly toward fundamental research created the possibility to be involved in 11 multidisciplinary national consortia, 4 as coordinator and 7 as partner. The novelty of researches was disseminated as 35 papers published in Web of Science journals, proceedings in the scientific event paper book or in periodicals indexed in recognized databases, 1 chapter book, and 4 patent applications.

Is important to underline that in analyzed period our team granted 4 national patents, 3 of them awarded gold and bronze medals at national innovation exhibitions (gold in 2010, and bronze in 2007 and 2010). Also, 2 patent applications were awarded at INVENTIKA 2011 with a silver medal and a bronze medal, respectively.

### 1. Materials /Technologies for industrial applications

In this direction the team had as a goal development of new materials/chemicals in close correlation with progress registered in nanoscience and technology for applications in electronics and optoelectronics, medicine, sensors for technical concern, obtaining of tailored materials for mechanical engineering, and industrial buildings. The research in this direction was concretized in the following 3 projects:

**Project CEEEX 21/2005-2007** *“Hybrid condensed systems with phthalocyanine and other oxygen bearing metal-complexes used for medical and ecological sensors and catalytic processes”* covered a large area of researches to identify those condensed systems with phthalocyanine and metal-complexes to be included in sensors for medical concern or for detection of different substances with toxic impact on environment or on human health, and used in catalytically industrial processes, as well. The scientific results were: 7 technologies for some phthalonitrile and quinacridone derivatives. Also, were published 4 articles in ISI journals and 1 patent.

**Project CEEEX 251/2006-2008**, “*Chromogen-polymeric composite systems for photoinduced surfaces and selective ion sensors*”, was initiated by ICECHIM work group for research the possibility to use the chromogen-polymeric systems to impart to the surfaces they are applied different properties able for sensors of technical concerns. The project was finalized with 8 technologies, 7 articles (6 ISI and 1 non-ISI) and 1 patent.

**Project PNCDI 71-092/2007-2010**, “*Mesomorphic chromogen-polymeric systems organized in supramolecular architecture for intelligent surfaces with controllable properties*”, represents a development of the previous CEEEX project no. 251/2006-2008 and has as main results 3 technologies, 14 articles (13 ISI and 1 non-ISI), and several communications, 2 patents (1 being awarded with a gold medal and a bronze one at innovation events organized in country in 2010).

## **2. Materials /Technologies for textile applications**

This research direction was developed in 5 projects (2 as coordinator and 3 as partner) in the framework of national R&D programs, as follows:

**Project CEEEX 23/2005-2008** “*Complex integrated system of technologies and products, meant for digitalization of textile printing*” was finalized with 18 micro(nano)technologies for obtaining 4 pigmentary compositions, nanodispersions with 4 pigments (yellow, magenta, cyan and black), for functionalizing from synthesis of 4 pigments, and for preparing inks with functionalized and nanodispersed pigments.

**Project CEEEX S2/C9/2005-2008** “*Comfort and performance vs. multifunctional textile materials for sport and leisure*”, has as target to develop compounds/compositions able to change their color in function of light intensity. The project was finalized with 10 reversible thermochromic compositions and with an optimized laboratory technology for the thermochromic dye Crystal Violet. The original results were disseminated as 2 works in scientific events in country.

**Project CEEEX C22/S4/2005-2008** “*Multifunctional technical textiles for Protection Clothes*”, has realized a protection cloth prototype with warning properties, based on 5 irreversible thermochromic compositions and an antifire compound, for the workers in high temperature processes or for the firemen. The research results were awarded with the first prize by ANCS in 2008. Also, the results were presented in a round table and a workshop organized by project coordinator – R&D National Institute for Textile and Leather.

**Project PNCDI II 31-053 /2007-2010** “*Advanced environment technologies in the textile industry and integrated systems of waste water pollution controlling and preventing*” has as final aim to elaborate a technology for remove the dyes, pigments or auxiliaries from wastewaters resulted in the textile industry (dyeing/printing processes) and so to control and prevent the environmental pollution. The originality of the technology was protected in 2010 by a patent application (A/01207).

**Project PNCDI II 72-148 /2008-2011** “*Technologies and nanomaterials for bioactive barrier functionalization of textile surfaces*” took into study some usual herbs extract with the purpose to obtain functionalized textile surfaces for medical use. The anti-allergic tests demonstrated the bioactive properties of the studied materials. Scientific results: 3 articles, 11 papers at international congresses/conferences, and a book chapter. Also, patent application A/00583/2011 was awarded with a silver medal at INVENTIKA 2011, and is under the European patent application procedure.

## **3. Materials /Technologies for medical applications**

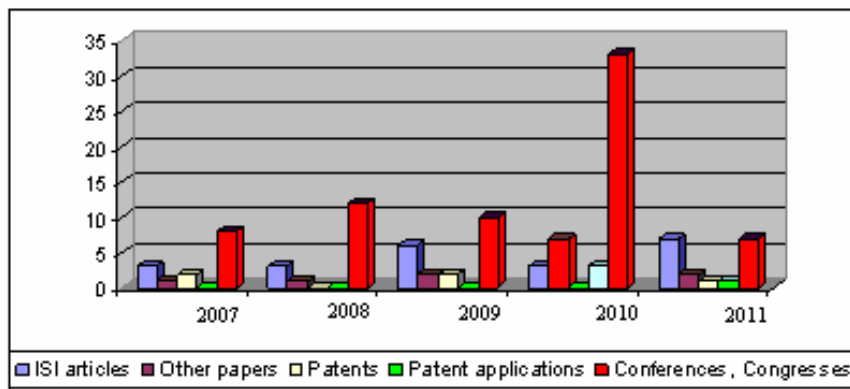
Within this research direction the team members has 3 projects with themes orientated toward materials/nanomaterials preparing for medical diagnostic and therapy:

**Project CEEEX 125/2005-2008** “*Alternative medicine by phitotherapy: epigenetic antitumoral effects and on proteomic components*” was finalized with 7 laboratory technologies for extraction and preparation of alcoholic or hydro alcoholic extracts from *Helleborus*, *Geranium Robertianum* and *Xanthium spinosum*.

**Project PNCDI no.11-034/2007-2010**, “*Nanostructured Systems for Viral Antigens identification used in Medical Diagnosis*”, has developed a method, based on liquid crystal optical disturbance, for detection of ligand-receptor interaction involved in medical diagnosis. The project out-puts: 1 patent application (A/01004/2010), 2 articles and several communications.

**Project PNCDI no. 61-023/2007-2010**, *Phthalocyaninic photosensitizers for photodynamic therapy. Synthesis and photophysics*, has studied 20 phthalocyanine compounds with potential properties as photosensitizers for PDT. Biological studies had revealed 2 compounds as real photosensitizers for cancer therapy. Our project work group initiated 2 oral presentations in scientific events.

### **Papers, proceedings, works presented to international and national conferences, books patents, and patent applications**



**Fig. 2:** Dynamic of scientific results

The dynamic of the scientific results, in the terms of ISI papers, articles in CNCSIS recognized reviews or proceedings listed in other databases, works presented to international and national conferences, books patents, and patent applications is presented schematically in the **Fig. 2**.

### **Collaborations**

The last 4 years are characterized by an intense collaboration with numerous prestigious research institutions and SMEs from Romania. Among the research institutions can be mentioned: Polytechnica University from Bucharest, Romanian Academy – Institute of Virology “Stefan S. Nicolau” and Institute for Physical-Chemistry “Ilie Murgulescu”, “Gh. Asachi” University from Iasi, National R&D Institute for Materials Physics, National R&D Institute for Textile and Leather, National R&D Institute for Lasers Physics, Plasma and Radiations, National R&D Institute for Microtechnologies.

Regarding the collaboration with SMEs can be mentioned the two traditional collaborators and co-financing company, SC ICPAO SA – Medias and SC CHIMCOLOR SRL, with activities in the field of materials and technologies for colored coverings with multipurpose uses.

### **Evolution of human resources**

As mentioned above, the “Multifunctional Materials for Advanced Technologies” team is an interdisciplinary one which consists in 10 certified researchers, from which 4 are PhD in chemistry and 2 PhD students. During the analyzed period, in the team were employed 2 young, 1 scientific researcher and 1 research assistant, who was certified as scientific researcher 2 years ago.

Is important to remark that all the team experienced researchers (Dr. Alexandrina Nuta, Dr. Wagner Luminita, Dr. Raditoiu Valentin, and Dr. Mircea Ruse) have conducted national R&D projects, were invited to be national evaluator experts for R&D national projects and reviewers for scientific journals, were members in the PhD thesis commissions, etc.

### **Other aspects**

✓ In this period some of the team’s members has supervised and hosted students for practical stages from Polytechnica University. Also, Dr. Wagner Luminita and Dr. Alexandrina Nuta co-supervised several PhD theses in the competence field.

✓ In the analyzed period, were made 4 international project proposals: **1 FP7-NPM-2007** and **3 MANUNET ERA-NET** (2 proposals at 2009 call and 1 proposal at 2011 call)

✓ All the team researchers are members of Romanian Society for Chemistry, Romanian Society for Dyers and Colorists.