

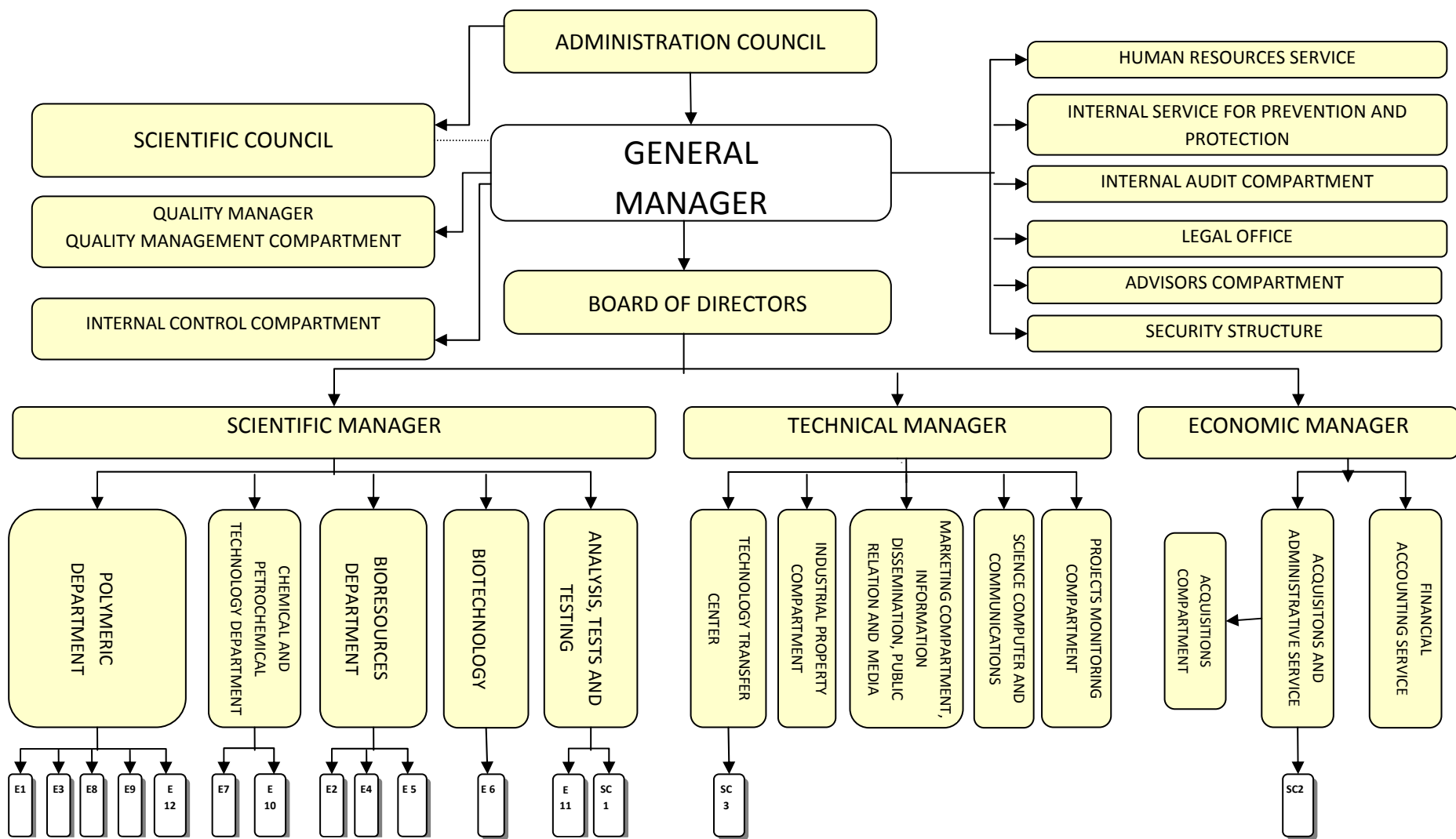
**NATIONAL INSTITUTE FOR RESEARCH AND DEVELOPMENT IN
CHEMISTRY AND PETROCHEMISTRY - ICECHM**

**SELF-ASSESSMENT REPORT
FOR THE PREVIOUS 4 YEARS**

THE NATIONAL INSTITUTE FOR RESEARCH & DEVELOPMENT IN CHEMISTRY AND PETROCHEMISTRY - ICECHIM BUCHAREST

ORGANIZATIONAL STRUCTURE

approved by the Administration Council in meeting on August 05, 2011



E1 - Advanced Polymeric Materials and Polymer Recycling (A. Sarbu)
 E2 - Alternative Bioresources and Biorefining (S. Velea)
 E3 - Antifouling -Elastomers - Resins (P. Ghioca)
 E4 - Bioactive Compounds (Bioproducts)(F. Oancea)
 E5 - Biofuels and Fuel Additives (E. Stepan)

E6 - Biotechnology and Bioanalysis (M.L. Jecu)
 E7 - Colloids and Surfaces. Industrial and Environmental Applications (A. Piscureanu)
 E8 - Eco-Friendly Multifunctional Materials (D. Dimonie)
 E9 - Heterogeneous Systems (D. Donescu)
 E10 - Multifunctional Materials for Advanced Technologies (A. Nuta)

E11 - Nanomedicine (R.M. Ion)
 E12 - Polymer Composites and Nanocomposites (Z. Vuluga)
 SC1 - Analytical Services Laboratory (V. Badescu)
 SC2 - Prototypes and Metrology (M. Blagan)
 SC3 - Technology Transfer (O. Frangu)

2.2. GENERAL ACTIVITY REPORT OF THE INSTITUTION (maximum 5 pages)

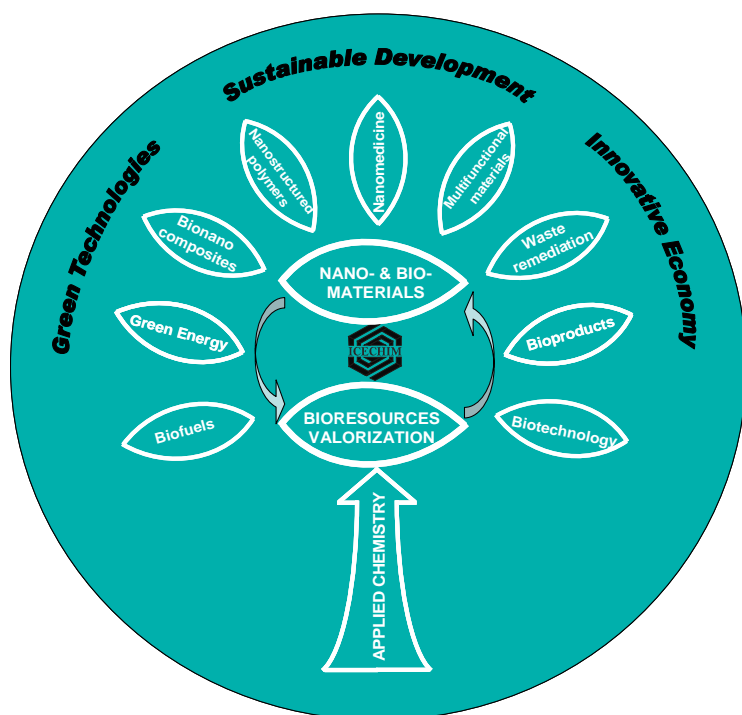


Fig. 1. The diagram of the main R&D direction of ICECHIM

A detailed description of the specific RD directions, achievements and many other aspects for each team is presented at the chapter 2.3.

MAJOR ACHIEVEMENTS OF THE INSTITUTION

ICECHIM has applied for numerous R&D projects in all national and international calls where it was eligible and a good rate of success was recorded. After 2009 the number of new projects has decreased dramatically due to the *lack of national calls* for the collaborative projects dedicated to applied research.

ICECHIM was/is *partner in several FP6/FP7 projects*:

- FP6 no. ACC-SSA-2-2004-017494 “*Enhancement the quality participation at FP6 projects in the polymer nanomaterials field – ENPONA*” (2005 – 2008) (750,000 Euro).
- FP6 FOOD-CT-2006-036296 “*Development of high throughput approaches to optimize the nutritional value of crops and crop-based foods (DEVELONUTRI)*” (2007 – 2011) (210,000 Euro)
- FP7 213436/2008 “*Nanostructured Toughened Hybrid Nanocomposites for High Performance Applications (NANOTOUGH)*” (2008 – 2011) (603,794 Euro)
- FP7 –NMP3-LA-2008-213277 ”*High Aspect Ratio Carbon based Nanocomposites (HARCANA)*” (2008 -2012) (550,000 Euro)

Also, ICECHIM is a sub-contracting partner in the project:

- FP7 226956/2010 “*Microencapsulation of oxidative and reducing selected substances, for soil purification (UPSOIL)*” (2010 – 2011) (15,000 Euro)

Other European Projects:

- LIFE 10 ENV/RO/734 “*Carbon dioxide mitigation from greenhouse gases in algal photosynthetic systems*” (2011 – 2014) (1,038,286 Euro)
- BS ERANET 7-045/2011 “*Innovative materials for waste water purification systems to be installed in tourist and other small polluting objectives on the Black Sea coast (IMAWATCO BS ERANET)*” (2011 – 2013) (80,000 Euro)
- CROSS BORDER project Romania – Bulgaria “*Danube WATER integrated management. WATER*” (2011 – 2013) (178,832 Euro)

The Research & Development activity of INCDCP-ICECHIM was focused in the last years on three interrelated directions:

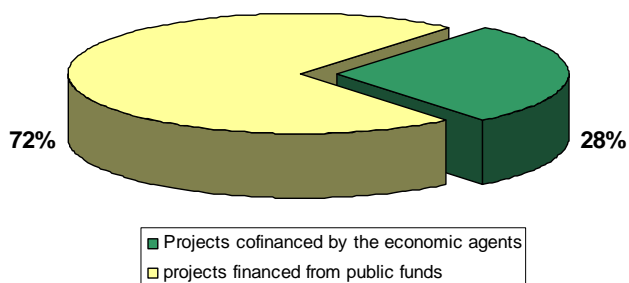
- Development of **innovative technologies for bio-resources valorization**
- Development of **new nanomaterials and biomaterials** for a wide range of applications
- **Sustainable management of the resources and environment**

Starting from these three main directions and from the expertise of our researchers, the interdisciplinary teams of ICECHIM approached research topics such as: *bioproducts* and *biofuels* preparation; *biotechnology* and *bioanalysis*; synthesis of *nanostructured polymers*, *bionanocomposites* and *multifunctional materials*; *waste remediation*; *nanomedicine*; *green energy* (Fig. 1). These topics correspond with the thematic priorities of the European and National R&D Programs.

Bilateral Projects

Since 2007 was involved in several bilateral projects: Romania–Turkey (2), Romania–South Africa, Romania–Germany, Romania–China. Currently, ICECHIM is involved in two bilateral- projects Romania–Bulgaria and in one project Romania–France.

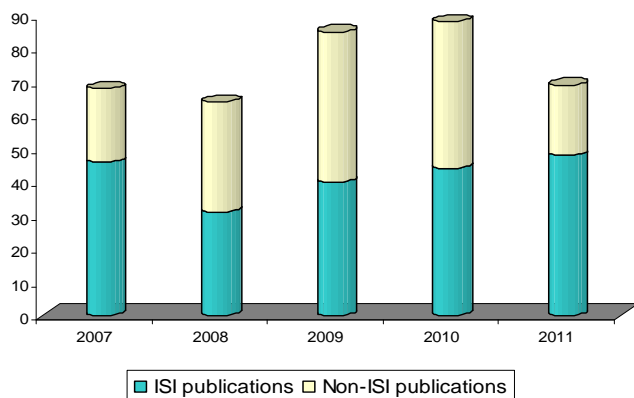
National Projects



Regarding the national projects, one of our priorities is the collaboration with the industry by developing technologies, products and services adapted to its requirements. In Fig. 2 it can be observed that 28 % from the total national collaborative projects are co-financed by partners from industry.

Fig. 2. Percentage of the projects cofinanced by industrial partners

The projects developed in the period 2007 – 2011 produced a wide range of results: technologies; procedures; methods; protocols; products; technical solutions; prospective studies; papers; communications; patents, etc.



As visibility criterion, the number of the *papers* published in ISI-quoted journals, as well as in journals and publications recognized by other databases (including books/chapter in books) recorded an increasing trend (Fig. 3). 48 papers published in ISI-quoted journals were reported for the first 11 months of 2011, and till the end of year are expected to be more.

Fig. 3. Dynamic of the ISI and non-ISI publications

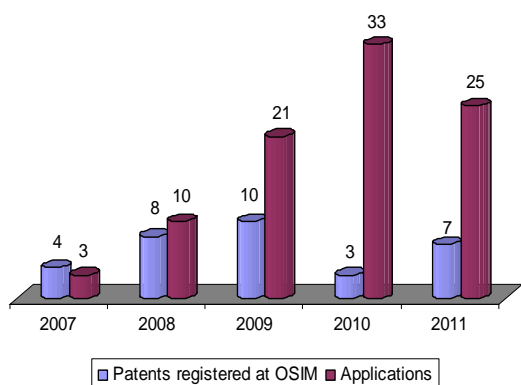


Fig. 4. Dynamic of the registered patents and of the patent application

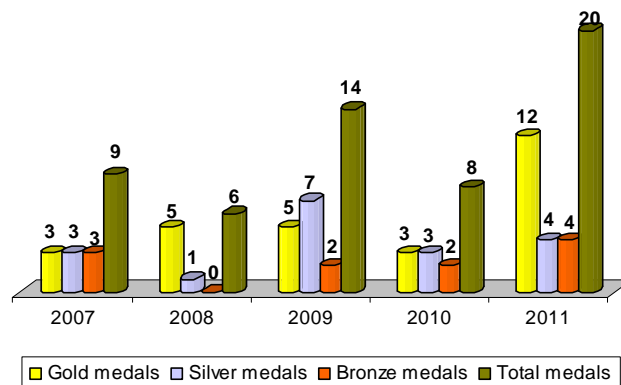


Fig. 5. Medals received by ICECHIM at the national and international fairs and exhibitions

The patenting activity has recorded a constant increase. In 2010 and 2011 the number of *registered patents* and *patent applications* was significant due to the finalization of the projects started din 2007 and 2008 (Fig. 4). Related to these, we mention the important number of the *awards and medals*

received in frame of the prestigious national and international fairs and exhibitions, such as: EUREKA INNOVA Energy Exhibition-Brussels, Salon of inventions from Geneva, Moscow, Zagreb, Nuremberg, Warsaw and Bucharest (Fig. 5).

At the request of the Ministry of Economy, Trade and Business Environment, as the National Authority which coordinates the R&D activity of ICECHIM, have been realized a series of **prospective / strategic studies**:

- Refining and petrochemistry industry - present and perspectives. Strategic elements for competitiveness (2008 – 2010)
- Eco-cleaning of the lands infested with refining wastes and products from scaffold production and refineries (2007 – 2008)
- Methods and technologies for acid treatment of the solid waste resulted from petroleum refineries (2007 – 2008)
- Recovery of polymer parts from ELV (End of Life Vehicle) dismantling (2007 – 2008)
- Separation and recycling of glass and plastics from waste electrical and electronic equipments (2007 – 2008)
- Treatment of packages from toxic products (2006 – 2007)

MAJOR INVESTMENTS

In ICECHIM, major investments were made both with national and European funds through the next projects:

- 1) Project FP6 no. ACC-SSA-2-2004-017494 “*Enhancement the quality participation at FP6 projects in the polymer nanomaterials field – ENPONA*” (2005 – 2008). The upgrading and renewal of existing research facilities was carried out by purchasing some highest performance instruments, complementary to the existing facilities for hybrid polymeric nanomaterials. Major equipments: Environmental Scanning Electron Microscope (ESEM), Measurement System of Particles Dimensions (by Dynamic Light Scattering), Molecular Weight and Z Potential (DLS), UV-VIS Spectrophotometer FT-IR Spectrophotometer
- 2) PNCDI II-CAPACITIES project CP 18/2007 “*Development of laboratory infrastructure for physical and mechanical characterization of polymers for testing plastics waste for recovery-DESPLAST*” (2007 – 2009). Two laboratories were developed, one for preparation and rheological characterization of polymer (nano)composites, and the second one, for mechanical characterization of polymer composites. Major equipments: Brabender (Plastograph; co-rotating double screw extruder; film blowing set with takeover and wrapping film system); Universal system Instron for mechanical testing equipped with video extensometer.
- 3) PNCDI II-CAPACITIES project CP 49/2007 “*Biotechnology & Bioanalysis Laboratory – B&B Lab*” (2007 – 2009). Four laboratories were modernized according to the GLP (Good Laboratory Practice) rules, with a special attention to the Microbiology Lab. Major equipments: System for taxonomic identification of the microorganisms MicroLog™ MicroStation™; Bioreactor for aerobic cultures with in-situ sterilization system (3.5 L volume); HPLC system with autosampler, “DIODE ARRAY” detector and fluorescence detector.
- 4) PNCDI II-CAPACITIES project CP 178/2008 “*Creating a centre of expertise for the characterization of polymer nanocomposites – POLINANO*” (2008 – 2010). 3 existing laboratories were equipped with last generation equipments. Major equipments: AFM microscope with atomic resolution for the investigation of samples surfaces; System for measuring interface properties; Laboratory press having automatic cycle for pressing, fine adjustable temperature and high force of sealing the mould; Manometric gas permeability tester; Thermal & Thermomechanical Analysis System
- 5) PNCDI II-CAPACITIES project PM/CP 1/2008 “*Development of the Bioresources Department by R&D infrastructure modernizing – BIORES*” (2008 – 2011) It was develop and modernize the existing infrastructure of the Bioresources Laboratory in order to establish a modern department with four laboratories: extraction, biofuels, bioproducts, tests and measurements. Major equipments: Photobioreactor (100 L volume), Continuous Flow Tubular Reactor, Lab Fermenter 5L, Supercritical Fluid Extraction System, GS-MS/MS Triple Quad, LC-MS/TOF.

Due to these projects, a good infrastructure is assured for developing of projects in the nanocomposites, polymers and functionalized materials, as well as in biotechnology and bioresources areas.

PERSONNEL RECRUITING ACTIONS

An important objective of our institute is to recruit young researchers which then become PhD students and are included in the ICECHIM's research teams in dependence of their specialization and of the needs of ongoing projects. Currently ICECHIM is in the final phase of the Human Resources Strategy implementation based on the *European Charter for Researchers* and the *Code of Conduct for the Recruitment of Researchers*.

Data regarding the dynamic of the employments, including the young researcher and the evolution of the number of the PhD students are presented in Fig. 6 and 7. Fig. 8 shows presents the evolution of the promotion contests organized in order to obtain the CS, CSIII, CSII and CSI titles.

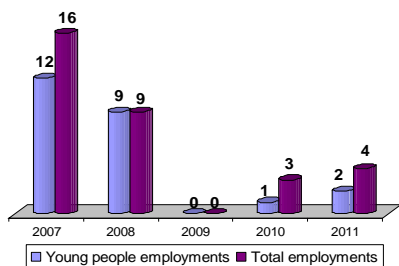


Fig.6. Employment actions

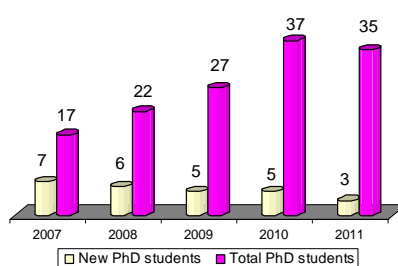


Fig.7. PhD students and PhD titles

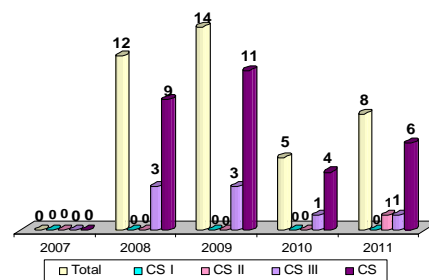


Fig. 8. Promotion contests

EVENTS

Since 2004, ICECHIM is organizing each year, in the end of October, the International Symposium **PRIOCHEM- CHEMISTRY PRIORITIES FOR A SUSTAINABLE DEVELOPMENT**. The priorities of this symposium are the dissemination and promotion of scientific research results and presentation of Romanian scientist results, as well as the maintaining contact and integration activities of Romanian specialists in the international scientific community and increasing their ability to provide solutions. PRIOCHEM is structured on following sections: Bioresources and biomaterials; Multifunctional materials and nanocomposites; Chemistry in medical and pharmaceutical applications; Protection and Environmental Engineering. In frame of the symposium various workshops/round tables and exhibitions related to the research results are organized.

Invited scientist / Invited lectures: Since 2007, more than 150 scientists from abroad have visited our institute and were invited to give lectures in their research field.

Workshops: Besides the workshops organized every year in frame of PRIOCHEM Symposium, ICECHIM has organized the **Exploratory Workshop "Emerging Analytical Tools to Quantify the Plant-Insect-Environment Interaction. New Science for the Next Generation Integrated Bio/Sensors and Probes"**, Bucharest, 16 - 18 November, 2011. This international workshop was organized in two-day sessions and the third day roundtables. The invited chair was Professor Wolfgang Knoll, AIT Austrian Institute of Technology, Vienna, and the host chair was Dr. Serban Peteu from ICECHIM.

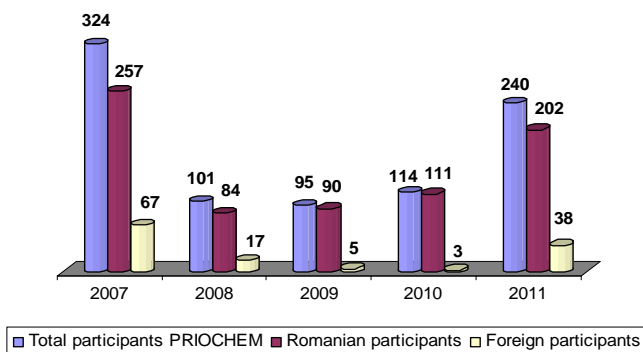


Fig. 9. Evolution in time of the number of participants to PRIOCHEM

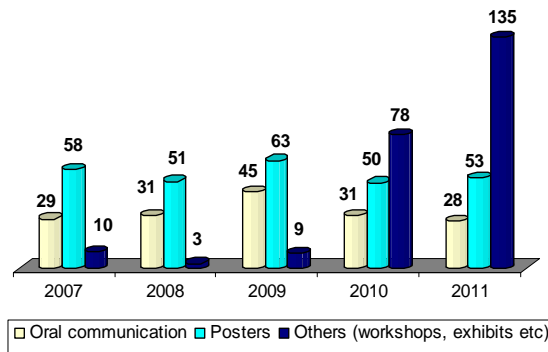


Fig. 10. Dynamic of the number of oral communications, posters, etc in frame of PRIOCHEM

TECHNOLOGY TRANSFER ACTIVITIES

One of the strategic objectives of INCDPCP-ICECHIM is capitalizing on the potential of the research results. On the basis of the ICECHIM's *Politics for Industrial Property*, for technology transfer it was founded in October 2010 a **Center for Technology Transfer (CTT)** which was accredited for a period of five years by The National Authority for Scientific Research (ANCS) according to the Certificate of Accreditation No.: 58/02.12.2012.

CTT-ICECHIM is part of the National Network for Innovation and Technology Transfer ReNITT and is member of the Romanian Association for Technology Transfer ARoTT. CTT activities focus on:

- Promoting technologies with capitalizing potential in national and international networks (Enterprise Europe Network - EEN), media, exhibitions, scientific and brokerage events; CTT-ICECHIM organized two round tables on themes of technology transfer;
- Increasing the level of information in science and technology (newsletters) and of visibility of CTT;
- Consulting and technical assistance in technology transfer and in *Industrial Property Rights (75 patent applications in 2007-2011)*;
- Valorization of research results – more than 50 beneficiaries of the results obtained by ICECHIM researchers: economic agents / R&D centers (S.C. PRO AUTO Industries S.A., S.C.CHEMIX S.R.L. , S.C. ATICA Chemicals S.R.L., S.C. Oltchim S.A., S.C. Gepro, S.C. ALCHIMEX S.A. etc / UPB, UB, UPG, UMF Carol Davila, IMNR, ICF, IPCUP, INCDMI Cantacuzino, ICDPP etc.);
- Creating partnerships with central and local authorities, research and development units, universities, SMEs and other institutions (technology transfer entities, chambers of commerce, etc.) to find new opportunities for collaboration (consortia projects, cooperation agreements on scientific / technical / technological and services);
- Professional performance in technology transfer improvement (courses, training).
Currently, as a result of negotiations with a trader, we prepare the transfer of a three technologies package related to the recovery of plastic PET waste.

COMMUNICATION and PUBLICITY ACTIONS

The entire activity of ICECHIM, including the R&D projects and their results are presented on the institute website: www.icechim.ro. Also, the main achievements and projects were presented to the general public via the written mass-media (Romania Libera, Financiarul, Inno-Barometru), as well as in national broadcast and TV debates/ interviews (Radio Romania Cultural, Radio Romania Actualitati, Antena 3, ProTV).

OTHER SIGNIFICANT ASPECTS

- The *Quality Management System* was certified by TUV-Hessen international certification body since 2010.
- The researchers from ICECHIM are members in various international and national *professional organizations*, such as: Polymer Processing Society, PRESUMO ITALIA, American Chemical Society, European Federation of Biotechnology, Romanian Chemical Society, etc.
- ICECHIM hosts and supports BSc, MSc and PhD students for practical stages and thesis
- Senior researchers from ICECHIM collaborating with Universities as full or associated professors: Prof. R. Ion, Dr. D. Donescu, Dr. A. Chirvase, Dr. A. Sarbu, Dr. M.L. Arsene). In ICECHIM there are three coordinators (affiliated to different universities) for Ph.D. students: Prof. Rodica Ion, Dr. CSI Dan Donescu, Prof. Mihai Dimonie.
- An important number of our senior researchers are reviewers for prestigious ISI-quoted journals such as: J Appl Polym Sci, Enz Microb Technol, Process Biochem, Eur Polym J, J Polym Env, Polym Eng Sci, JFCA, NOx, etc.
- More than 10 senior researchers were selected to be evaluator experts/monitors for national RD projects and 3 (Dr. A. Chirvase, Dr. M. Badea-Doni, Prof.Dr. R. Ion) for EU projects.
- Mobility for young researchers and PhD students: one PhD student made the PhD thesis at Aalborg University, Denmark, where she continues with a postdoctoral stage; other 8 students spent doctoral stages of several months in institutes/universities from France, Slovakia, Germany and Holland.

2.3. ACTIVITY REPORT BY TEAMS (maximum 3 pages per team)

E 1: ADVANCED POLIMER MATERIALS AND POLYMER RECYCLING

The team deals with **last generation polymer materials based mainly on supramolecular chemistry**: Hybrid inorganic-organic nanocomposites (more than 50% inorganic), polymer hydrogel composites, molecularly imprinted polymers, immobilization of enzymes and microorganisms on polymers, functional synthetic fibers and membranes, polyurethane foams and copolyesters with tailored properties, but also with the recycling of PET bottles and with application of polymer wastes for new building materials.

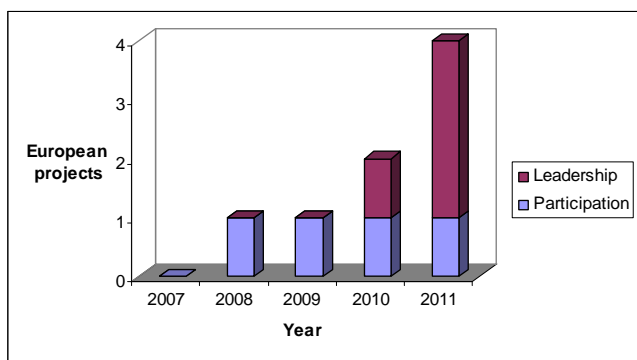
The early team members worked formerly in the field of synthetic fibers. Because in Romania the synthetic fibers industry disappeared during the last 20 years, the research direction was changed: some members began to work in the field of polymer recycling (PET bottles and others), other members began to work in the field of nanomaterials. The change of the research direction was facilitated by the 2 years Post doc of the team leader: Sarbu Andrei at Technical Superior Institute from Lisbon. Young researchers are working now in several modern new fields: polymerization in inorganic structures or in inorganic concentrated suspensions, MIP obtaining by bulk or microemulsion polymerization, immobilization of enzymes on polymer membranes and grains.

The team explored new areas of research: host- guest radical polymerization in mesoporous silica and zeolites, hydrogel composites for gelcasting of ceramics, MIP obtaining by phase inversion, immobilization of enzymes for biosensors, chemical recycling of PET for new biodegradable polyesters including renewable resources, new polyurethane foams, poliesterdiols, surfactants or plasticizers, joining fundamental with applied research. Most of the developed research work ranges at the boundary between chemistry, physics and biology: covalent immobilization of enzymes on polymers, biosensors, use of MIP for selective separation of bioactive substances from phytoextracts, inorganic- organic nanocomposites. One of the young members has got a Post Doc grant, having as mentor the team leader, the subject being the chromatographic chiral separation on MIPs. A new project was recently proposed for the preparative separation on MIP of the highest active enantiomer of hypericine from Saint John's Wort extracts.

Between 2007- 2011 the team participated in 13 national projects from public funds: 7 projects in coordination and 6 projects as partner.

Entrepreneurship initiatives: Private funds financed contracts: as coordinator, 2 contracts amounting to 506800 lei and as partner 1 contract summing up to 45000 lei. A technology transfer agreement: 5000 Euro = 21000 lei. Providing Services Contract (Partner): Total 3408 lei. Analysis orders: 4771 lei **Total private funds earned:** $551800 + 21000 + 3408 + 4771 = 580979$ lei (**145.245 euro**)

Figure 1 presents the evolution of international projects. Members of our team worked in a **FP7 project (NANOTOUGH)** in which ICECHIM was partner.



The team is Coordinator in **Black Sea project ERANET: IMAWATCO**. The consortium members are: Institute of Organic Chemistry and Institute of Space Research of Bulgarian Academy of Sciences and Istanbul Technical University, (October 2011- December 2013) Total funds ICECHIM: EUR 80.000, out of which in 2011: EUR 10,000, about 43000 Lei.

Figure 1: Evolution of international projects

Bilateral projects:

1. HIOPONAPAM, bilateral cooperation with the Institute of Organic Chemistry, Academy of Sciences Bulgaria, October 2010 - September 2012 Total funds: 39194 Lei,

2. SIGONAPOL, Brancusi collaboration with the University of South Toulon-Var in Toulon, April. 2011 - dec. 2012 Total funds: 27370 lei. In 2011 a PhD student from Toulon spent a 3 weeks stage in our team.

The team has cooperation relationships with: Superior Institute from Lisbon, Coimbra University, University from Rouen, University from Po, University from Strasbourg and Institute of Polymers of Slovak Academy. The team leader was invited professor for 1 month, during May 2011, in University of South Toulon- Var.

Results obtained over 2007-2011

Scientific results

In 2007-2011 there were published 17 ISI articles, 9 articles in journals CNCSIS B and 7 articles in proceedings. 95 communications and posters were presented at various congresses and symposia. 5 patents were awarded and 12 new patents are under examination at OSIM. 2 European Patents Applications were submitted.

Figure 2 presents the evolution of publications and participation at international conferences and Figure 3 presents the framing evolution of publications (ISI, B CNCSIS and Patents applications).

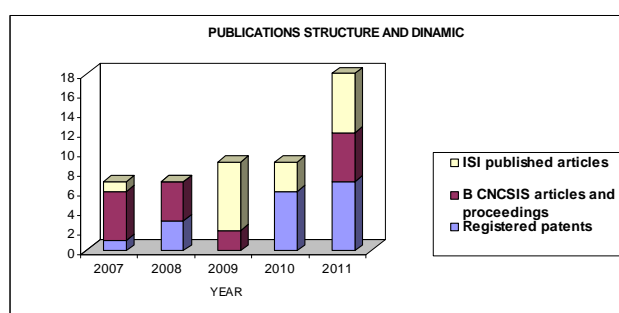
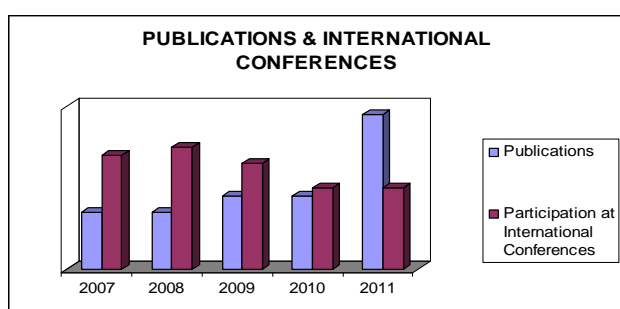


Figure 2 Evolution of publications and participation at international conferences **Figure 3 Framing evolution of publications**

Among the ISI articles published by our team the most representative are:

1. "Thermogelation properties of poly(N-isopropylacrylamide) – block – poly(ethyleneglycol) – block – poly(N-isopropylacrylamide) triblock copolymer aqueous solutions" Mircea Teodorescu, Ioana Negru Paul O. Stanescu, Constantin Draghici, **Anamaria Lungu**, **Andrei Sarbu**, Reactive & Functional Polymers 70 (2010) 790–797
2. "A₂BA₂ Block Copolymers of Poly(N-isopropylacrylamide) (A) and Poly(ethylene glycol) (B): Synthesis and Thermal Gelation Properties of Aqueous Solutions", Mircea Teodorescu; Ioana Negru; Paul O. Stanescu; Constantin Drăghici; **Anamaria Lungu**; **Andrei Sarbu**, Journal of Macromolecular Science, Part A, 48 (2), 2011, 177-185

Registered patents:

1. Biocide agent and process for treating textiles. Patent no. 121 284/ 2007. Authors: **Sarbu Andrei**, Cosmin Victoria, Udrea Ion, Amariutei Viorica, Bercea Vasilica, Balan Gabriela, Pricop Foarea, Sarbu Liliana, Vamesu Mariana
2. Procedure for obtaining a liquid fuel. Patent No: 122042/ 2008, Authors: Stratula C, Ionescu M, Roibu C, Preoteasa Veronica, **Capitanu Stanca**
3. Procedure for obtaining sucrose polyester polyols based on high functionality Patent No. 122723/2010, Authors: Ionescu M., Roibu C., Preoteasa Veronica, **Capitanu Stanca**, Bejenariu I., Oleg S., Murgoci Adriana, Tataru Elena
4. Polymeric membranes containing covalently immobilized enzymes on polymers and process for their obtaining Patent no. 123276/2010 Authors: Udrea Ion, **Sarbu Andrei**, Nechifor Gheorghe, Lucian Radu Gabriel, **Beda Mariana**, Sarbu Liliana, Neata Marian, Mihalache Nicoleta
5. Process for obtaining cellulose acetate fibers with covalently immobilized enzymes Patent No. 123280/ 2011 Authors: **Sarbu Andrei**, Udrea Ion, Sarbu Liliana, **Beda Mariana**

Results with potential industrial applications:

Homologated Technologies:

1. Conditioning technology for polyol component "Petol C 2120"
2. Lab-Scale Technology for obtaining a polyol component for polyurethane binding agents (Contract no. 1238/DP/2009)
3. Polyol compositions for viscoelastic polyurethane molded foams (Contract no. 1238/DP/2010)
4. Pilot-Scale recycling technology for wastes from the manufacture of phthalic anhydride by o-xylene oxidation process (No.2176/05.10.2007 Approval Minutes)
5. Pilot-Scale technology for obtaining plasticiser for PVC by chemical recycling of PET wastes (Nr.765 / 02/04/2007 Approval Minutes)

Homologated Products:

Petol 28-3B product certification by EUROFOAM Austria and EUROFOAM Romania, industrial production sold in 2009: ~ 1050 tones (value: EUR 1.26 million)

Human resources:

The evolution of team structure per age between 2007 and 2011 is presented in figure 4. It can be seen that the number of young researcher increased, now the team having a rather equilibrated structure. In the same time it can be noticed a steady increase of the PhD and PhD students number.

3 PhD students already presented the thesis in the professorial committee and within 1-2 month they will face the public defense.

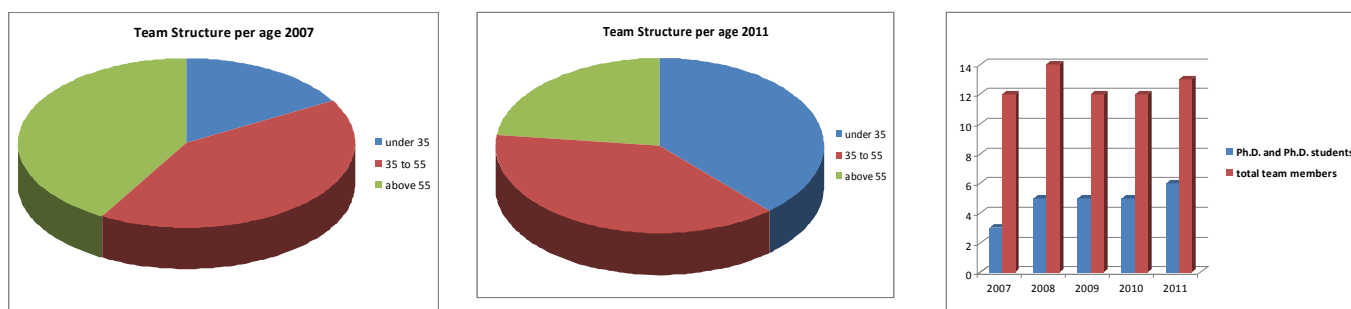


Figure 4: Evolution of team structure per age from 2007 to 2011.

Figure 5: Evolution of team scientific qualification between 2007 and 2011

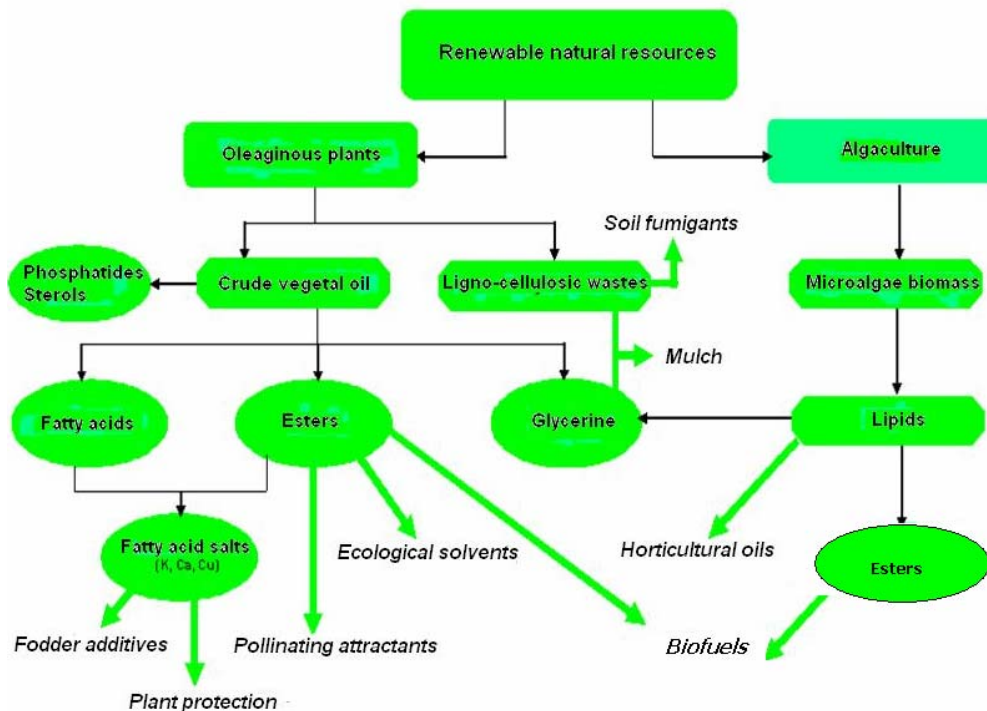
Other significant aspects:

- In 2010, 2 PhD students from our team spent a doctoral stage of 4 month in the University of South Toulon-Var, dealing with modern topics such as molecularly imprinted polymers by microemulsion and hybrid polymer inorganic-organic- nanocomposites. In 2011, another young PhD student spent another doctoral stage of 3 month, in the same university, working in the field of enzymes activity.
- In 2007, 2009 and 2010, Dr.eng Andrei Sarbu was invited in MIEC Symposium at La Valette du Var, Seyne sur Mer and Hyeres, to present the group activity in the field of polymers for environment.
- Prof. Alain Perichaud from University of Marseille and Prof. Andre Margailan, Francois- Xavier Perrin and Catherine Branger from University of Toulon were invited by our team to visit the institute.
- A PhD Student from France spent a doctoral stage of 3 weeks in our laboratories.
- Between 2007- 2011, the team leader was reviewer for the following scientific journals: Journal of applied polymer science (7), Journal of food biochemistry (3), Enzyme and microbial technology (2), Process biochemistry (2), African Journal of microbiology research (2), European polymer journal, Polymer international, Journal of membrane science, Journal of polymers and environment, Materials chemistry and physics, Journal of petroleum and gas engineering, Philippines journal of science, Materiale Plastice, Revista de chimie.
- The team leader was evaluator in national programs and in the following international programs: Research Science Fund Bulgaria (Grants for postdoctoral training in foreign scientific organisations and compulsory work in a Bulgarian scientific organisation and IDEAS- Bulgaria) (2008), Crosstexnet (2010 and 2011).

E 2: ALTERNATIVE BIORESOURCES AND BIOREFINING

Research team is formed by 9 member: 7 Senior scientific researcher (2 PhD) , 2 Scientific researcher (1 PhD student); team leader is Sanda VELEA, PhD, Senior scientific researcher.

The research domain:



- Sustainable biosequestration of GHG in microalgal photosynthetic systems with high algal biomass productivities in order to complete valorisation such as: algal oil for biofuels and horticultural oils; antioxidants as food additives, food dyes and dietary supplements; fluorescent pigments for medical use; polysaccharides as biopolymers; coproducts such as feeds, fertilizers and soil conditioners.
- Processing and refining of vegetable oils with obtaining of high value added products such as: biofuels; ecofriendly solvents for industrial applications; fatty acids salts (potassium, calcium, copper) as ecological crops protection agents and feed additives; pollinator attractants;

Brief quantitative and qualitative presentation

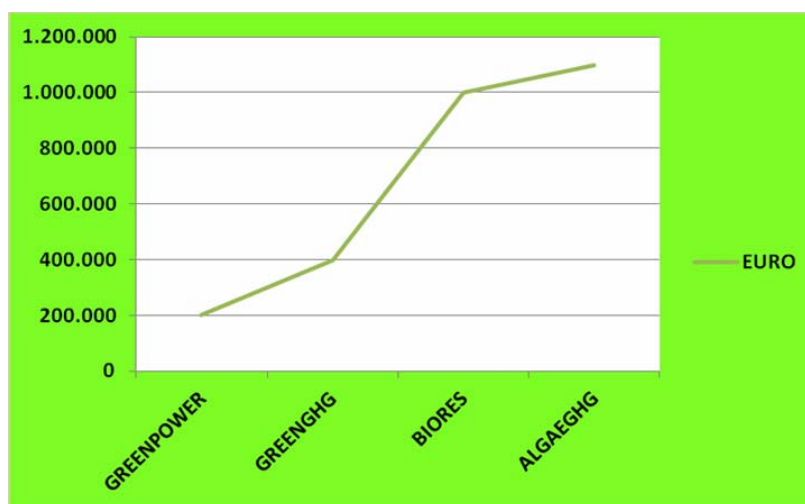
During the last years, the economic factors generated by the alarming increase in the price of oil and in close connection with the possible exhaustion of mineral resources, and also for environment related reasons, such as the negative impact of CO₂ emissions, have lead to a reconsideration of interest towards renewable natural resources as raw materials for biofuels, bioenergy (heat and electricity) and chemical products.

Bioresources are a sustainable alternative as raw materials for achieving environment-friendly products with “clean” processing and production techniques with a positive impact on the environment.

Development of the Bioresources Department by creating of 4 modern laboratories, equipped with high-performance research equipment, was performed in the framework of BIORES Project.

By this modern infrastructure was possible to develop new projects and partnerships based on the valorization of renewable natural resources for environment protection, energy and sustainable development:

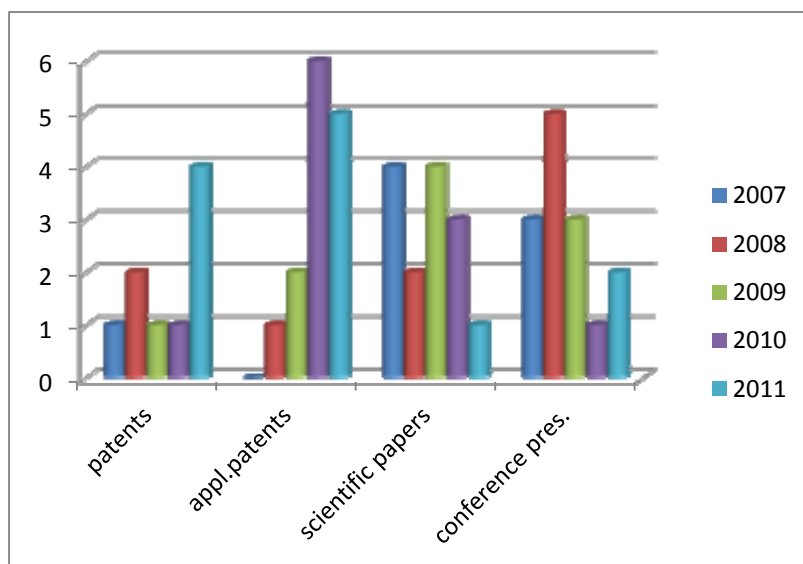
- National Project CEEEX "Bio-fuels and horticultural oils by means of controlled cyanobacterial photosynthesis" ; 2006-2008; Project Manager Sanda VELEA
- National PNII Project „Sustainable carbon dioxide sequestration from thermal power plant emissions by algal photosynthesis” 2009 -2011; Project Manager Sanda VELEA
- National Capacities Project „Development of the bio-resources department by upgrading the R&D infrastructure’ ; 2009 -20011; Project Manager Sanda VELEA
- European Project LIFE10 ENV/RO/734 : ” Carbon dioxide mitigation from greenhouse gases in algal photosynthetic systems”; Project Manager Lucia ILIE; 2011-2014
- European COST CM0903: „Utilisation of biomass for sustainable fuels & chemicals” ; 2009-2013
- European Project Application „Hydrocarbon-enriched feedstocks by combined bio-chemocatalysis”
Coordinating organisation : University of Nottingham, United Kingdom, Nov.2011



Evolution of financial resources attracted in national and international projects.

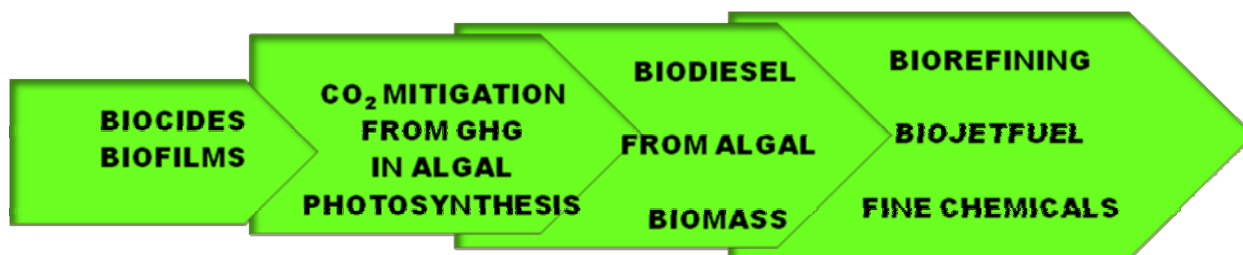
The most important achievements was in the field of carbon dioxide biosequestration from industrial emissions by photosynthetic integrated systems, by selection of some algal strains able to capture significant quantities of carbon dioxide, monitoring and optimization of growth processes, identification, isolation and characterization of useful products from algal biomass. Experimental studies have been accomplished for five domestic algal strains: *Chlorella homosphaera* 424, *Scenedesmus opoliensis* 141, *Chlorobotris simplex* 15, *Synechocystis sp.* 51, *Porphyridium purpureum* 337, with high growth potential in complete mineral nutritive media, allowing to use high concentrations of NaHCO_3 / Na_2CO_3 , with high yields in algal biomass and with high content in useful products (lipids, polysaccharides, pigments, etc). It was conceived and achieved a „prototype model”- the integrated photosynthesizer system - adapted for carbon dioxide capture and bio-sequestration from industrial emissions, through specialized algal strains.

In this period reserch team members published 14 scientific papers in ISI journals and non-ISI journals, **registered 7 patents and 13 patent applications**, and presented 14 communications at international symposia / conferences.



Dynamic of scientific team results

Dynamic research topics and directions



Interdisciplinary and entrepreneurial initiatives:

LIFE 10 ENV/RO/734 European project: „**Carbon dioxide mitigation from greenhouse gases in algal photosynthetic systems**” is devoted the development of a demonstrative integrated photosynthetic system at CET VEST Bucharest

Other significant aspects for scientific development of the team:

- Patent RO 123,178 “Process for obtaining of diesel biofuel from wastes”, **Gold Medal** and **Special Prize of OSIM**, International Exhibition of Inventions, Bucharest, October 7-10, 2008,
- Patent RO 121,913 “Diesel biofuel and process for obtaining the same”, - EUREKA INNOVA Energy Exhibition, Brussels, November 24th, 2007, **Gold Medal with mention**;
- RO Patent 121,859 2008, “Ecological solvent and process for preparing the same”, 35^e Salon International des Inventions des techniques et produits nouveaux, Geneve 18-22 avril 2007, **Gold Medal** and **IFIA ECO PRIZE, 2007**; 8th International Saloon for Industrial Property , Moscow, march 14-18, 2005, **Excellence Diploma** awarded by Russian Office of Intellectual Property, Patents and Marks
- RO Patent Applications A00288-2009 „Process and photobioreactor for carbon dioxide biofixation, from greenhouse gases” INVENTIKA- Bucharest, October 28-31, 2009, **Gold Medal**
- RO Patent 123027, 2010, Sanda VELEA, **WIPO Prize for the best women inventor**, INVENTIKA, Bucharest, October 2011.

E 3: ANTIFUOLING - ELASTOMERS - RESINS

R&D areas of Team 7 belong to the **Polymer Science:**

- radicalic polymerization in heterogeneous phases, polymers modification by chemical reactions, synthesis of polymer–silicate composites and nanocomposites, synthesis and characterization of various macromolecular compounds and hybrid materials;
- synthesis and characterization of bio-degradable polymeric composites based on renewable resources;
- anionic synthesis and characterization of styrene-diene block-copolymers, their modification by analogous reaction and using in recycling of polyolefin materials;
- synthesis of liquid, semisolid and solid Epoxy Resins and modification various diluents and/or mineral fillers;
- synthesis and characterization of hydridin elastomers based on binary and ternary copolymers of oxiranes;
- modifications of polymers by cross metathesis and ROMP in the presence of Grubbs catalyst;
- synthesis of antifouling composite materials which (coating) must have double roll anticorrosive and antifouling protection.

Projects and achievements

- **Project Inovare 209 /2008-2011** “Innovative materials for UV photopolymerizable coating materials“(MATUV) has realized two technologies for synthesis of di- and tri- block styrene-butadiene copolymers. Using these polymers was obtained one technology for protective coating of metals in the chemical milling process. The project results: 1 published paper, 1 participation at PRIOCHEM and 1 patent application (OSIM no. A/ 00945/18.11.2009).

- **Project PNCDI II no. 32 -169 /2008-2011** “Intelligent polymer composites with antifouling properties for maritime ships insulation and antifouling protection. Identification antifouling materials influences against sea environment“ (ECOMPUR) has realized two technologies composite modified polyurethane based with antifouling properties based on organozinc and organocopper, 7 specific trying methods (standards). The project results: 2 patents application (OSIM no A/00497/24.05.2011, and A/00972/29.09.2011), 3 participations at PRIOCHEM, and 2 participations at International Conferences.

- **Project CEEEX 177/2006-2008** “High-performance materials based on chemically modified and/or nanostructured polymers for industry and medical applications“ (MATPOLMOD) was obtained one technology for synthesis a new styrene-butadiene block-copolymer with controlled polybutadiene microstructure. The project results: 1 published paper, 1 participation at PRIOCHEM, 1 participation at Macro Iasi.

- **Project PNCDI II no 72-193/ 2008-2011** “Innovative technology and plant for making selective biocompatible membranes with the human blood destined to an extrabodily oxygenating device“ (MEMBIOX) has realized one technology for making selective membranes biocompatible with the human blood destined to an extracorporeal oxygenating device.

- **Project CEEEX No. contract S 13 /2005-2008** ”Polymer-layered inorganic nanocomposites as hybrid reinforced at nanometrical scale” has obtained one technology for the synthesis of a reinforced new inorganic nanocomposites by layer structure. The project results: 3 published papers, and 2 participations at International Conferences.

- **Project PNCDI II No. 71-125 (1519)/2007-2010** “Advanced materials for aerospace and transportation: nanocomposite polymer / reinforced carbon with carbon fiber and silicon carbide structures”. The project obtained the epoxy nanocomposites based on nanocarbon and nano silicon carbide reinforced with carbon fiber/glass for obtaining advanced materials for aerospace and transportation. The project results: 2 article and participated in 6 conferences at International Conferences.

- **Project PNCDI II No. 71-092 /2007-2010** “Mezomorfe chromogen-polymer systems organized supramoleculare architectures for smart surfaces with controllable properties”. The project obtained polymeric mezomorfe systems with liquid crystal characteristics. The project results: 2 published articles and 1 participation at national conferences.

- **Project PNCDI-PN II No. 31-049/2007-2010** “Construction elements of nanocomposites based on phase change materials (PCM)-epoxy for waste storage and solar energy used in buildings with low energy consumption". The project obtained the epoxy materials for solar energy and waste storage building with low energy consumption. The project outcomes: 1 article and 4 participations at International Conferences, 1 patent application (OSIM no. A/ 00242/ 17.03.2009).

- **Direct contract No.1714/2008** - „Rehabilitation of pipelines to transport natural gas under pressure”, Beneficiary: S.C. PROFGAS S.R.L.

- **Direct contract No.74 / 2007** - “Studies to identify trouble-shooting technology type lack of material on the pipes under pressure, using complex shells", Beneficiary: Oil – Gas University Ploiesti.

- **Project CEEEX Contract No. 234/2006-2010** "Methodologies for the development and characterization of polymer nanocomposite dielectric properties of insulating".

- **Project CEEEX Contract No. 445/ 2005-2008** "Advanced multifunctional materials doped with silver nanopowders”.

Evolution in time:

- The technological research intensification for obtaining new materials either by synthesis, especially by modification of existent polymers either by post-polymerization reactions or by nanocomposites obtaining. Thus there were obtained advanced materials for aerospace and transport based on carbon nanocomposites and storage residual materials using solar energy for low energy buildings.
- There was obtained a progress in application in technologies development of fundamental knowledge in inorganic chemistry, supramolecular chemistry (host-guest chemistry), radiochemistry.
- There was obtained intelligent polymer composites with antifouling properties for maritimes ships insulation and antifouling protection and was determined the influences of antifouling materials against sea environment.

Interdisciplinary initiatives:

- for the development of new polymeric materials were used interdisciplinary knowledge of organic and inorganic chemistry, physics, physical chemistry of polymers, supramolecular chemistry, radiochemistry, statistical mathematics, process engineering.
- nanocomposites synthesis: combining information from polymer chemistry and inorganic chemistry.
- fire extinguishing powders synthesis: combining information from inorganic chemistry and organic chemistry.
- calixarene applications: assembling a team with interdisciplinary knowledge: supramolecular chemistry and radiochemistry.
- for the development of the starch-based materials were used interdisciplinary knowledge of chemistry, physics, physical chemistry of polymers, statistical mathematics, process engineering.
- in synthesis and characterization of new styrene-diene block-copolymers were used interdisciplinary knowledge of macromolecular chemistry, mechanical, rheological and physical chemistry of polymers.
- epoxy nanocomposite with different nano fillers: nanocarbon, silicon carbide, molybdenum sulphide for obtaining advanced materials for aircraft, construction transport;
- epoxy materials for solar energy and waste storage building with low energy consumption;
- modified epoxy resins by synthesis for application concerning the reduction and control of structural vibrations (construction materials; automotive, aviation).

The team has well relationships in many complex projects with Physical Chemistry Institute "Ilie Murgulescu", Chemistry Faculty from the “Politehnica” University Bucharest, INCDFLMR, Elie

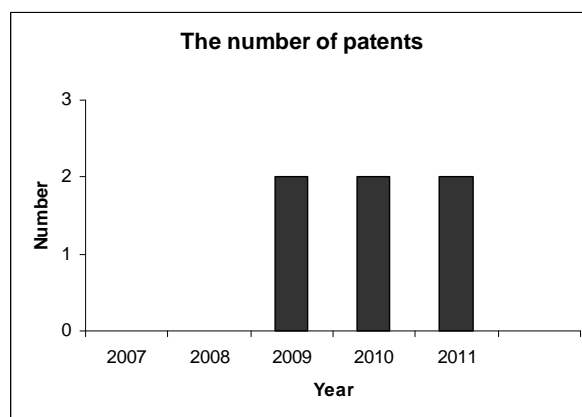
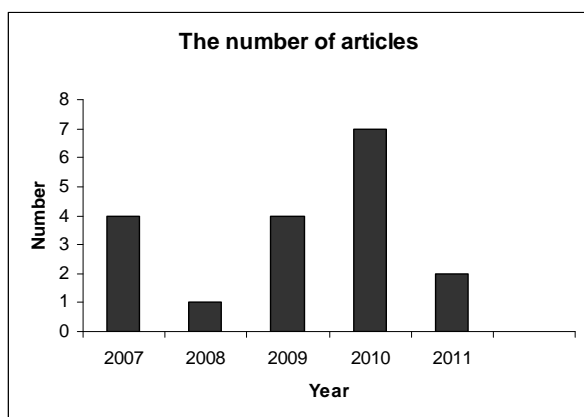
Carafoli Aerospace Research Institute, Organic Chemistry Center “C.D.Nenitescu” of Romanian Academy, Research Center for Macromolecular Materials and Membranes.

Visibility activities (from 2007):

For the dissemination of results were published 18 articles and numerous communications were performed at national and international symposiums and conferences.

For protection of research results were registered **6 patent applications**.

The evolution in time of the published articles and patent applications are presented in the next figures:



Human resources evolution:

In 2008 -2011 period were obtained a PhD title, two PhD stages are also in progress.

Two CS III degree research were obtained, and many knowledge refreshing courses were absolved.

In 2008 was employed a new chemical engineer absolvent of “Politehnica” University –Bucharest.

Other significant aspects

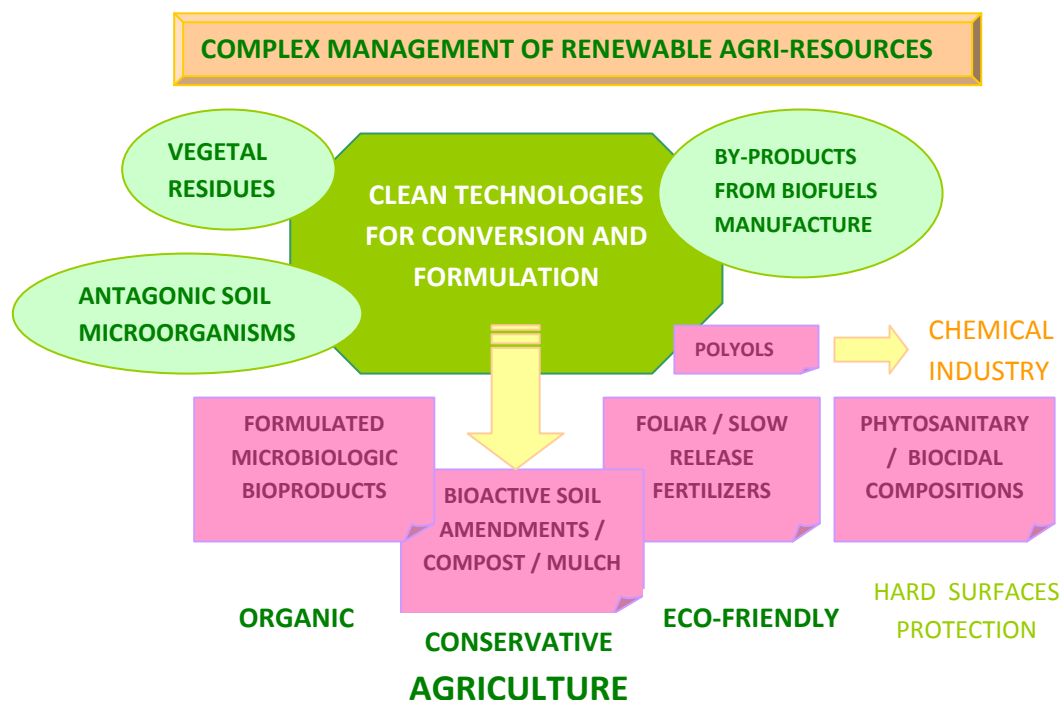
One member of our research team was reviewer/member in the Editorial Board of the ISI quoted journal “Mat Plast”.

An important attention was given to the **continuing vocational training** of our team’s members in the specific scientific areas and in other fields, such as the European funding rules, by participation to various courses and seminars.

E 4: BIOACTIVE COMPOUNDS (BIOPRODUCTS)

Short description of the research domain

The main research activities were conducted within direct contracts and national R&D projects to improve the exploiting level of renewable resources from agricultural activities into eco-friendly added value (bio)products by clean technologies for sustainable development of industry and agriculture: advanced intermediary materials and technologies for chemical industry, ecological surface biocide compositions, liquid and granulated slow-release fertilizers and bioproducts (based on vegetal and microbial active principles) for organic farming.



Research direction change

The transition from chemical synthesis of intermediates for pesticides to semi-synthetic technologies and so-called „green chemistry” processes is the main research direction change. As examples, chemical intermediates for industrial production of polyurethanes were replaced with polyols from renewable natural resources, inorganic fertilizers with organic slow-release fertilizers and conventional pesticides with eco-friendly alternatives based on vegetal active principles and microbial strains with agricultural applicability as antagonistic agents against pests and diseases of cultivated plants.

New area of research explored

Techniques for restoration and conservation of cultural heritage and eco-efficient means of production and application of organic biocide compositions is a new area of research to find solutions for the treatment of biodeteriorated wood and stone monumental surfaces and their long-term protection against recontamination.

New interdisciplinary initiatives

As an applied research oriented team, we aimed to conceive and obtain new products and to develop transferable technologies for the manufacture of organic intermediates for polyurethane foams, biocides with multiple applicability, plant protection products and slow release fertilizers with lower impact on agro-ecosystems and minimal residuals in food chain. Collaborations with experts in biochemical and nanotechnologies are initiated for extraction and determination of trace elements in

natural resources, nanofertilizers and vegetal active principles, electrochemical detector and means being also proposed for assaying traces of dangerous/hazardous substances. In order to increase the competitiveness of manufacturing biofuels we proposed the total valorization of raw materials through the conversion of technological wastes and by-products to added value novel (bio)products useful for nutrition and protection of cultivated plants, which involved interdisciplinary approach: biology, microbiology, biotechnology, chemistry, biochemistry, physics, agronomy, physiopathology. Research partners in PNCDI projects: R&D Institute for Plant Protection - Bucharest, R&D Institute for Pedology and Agrochemistry - Bucharest, Research Center for Membranes and Macromolecular Materials - Bucharest, Research Institute for Organic and Auxiliary Products – Medias, IPROCHIM – Bucharest, Institute of Physico-chemical Research “I. Murgulescu” – Bucharest.

Entrepreneurship initiatives

Several significant results were considered able to generate start-up or spin-off project proposals such as the data included in Patent/Patent applications regarding microencapsulated fertilizers, biocides and microbial compositions. These data were constituted as deposits to Technological Transfer Department of ICECHIM to find potential beneficiaries for implementation. There were realised industrial research and experimental development to elaborate novel technologies based on direct contracts between ICECHIM and a representative unit of Romanian chemical industry, SC Olchim SA Rm-Valcea. The main goal of implementing these technologies was to substitute petrochemically generated products with similar products with renewable natural origin. A strategy of development of national fertilizer industry, its present and future, was elaborated to be used by Ministry of Economy. Strategic elements to increase the competitiveness of fertilizer industry were proposed after a prospective outlook on world trends and evolution.

Visibility actions

Some of the most representative inventions were presented and awarded at International Fairs and Exhibitions of Inventions, Scientific Research and New Technologies such as: Innova Eureka, Nov. 13-15th 2008 and Nov. 17-19th 2011, Bruxelles, Belgium; IWIS 2011, Nov. 3-5th, Warsaw, Poland; The 37th Exhibition of Inventions, Techniques and New Products, April 3-5th, 2009, Geneva, Switzerland; Inventika in Oct. 28-31st, 2009 and Sept. 6-9th, 2010, Bucharest, Romania. There were obtained 3 gold medals, 5 silver medals, 1 bronze medal, The special prize of the Minister of Science and Higher Education, OMPI Award, Moldavian State University Diploma and important visibility, recognition and appreciation in the scientific international community. An International Exploratory Workshop was held at ICECHIM 16-18th November 2011, with a large international participation of PhD scientists and professors. Also, International Conference and networking "Diaspora in scientific research and higher education in Romania", Workshop: "Sustainable solutions to emerging challenges in agro-food with implications for human medicine", Bucharest, 21-24 September 2010; International Symposium of the Chemical Societies of Chemistry of the Southeastern Europe countries, Sofia – Bulgaria, September 2008 and every year in the last days of October, The Priochem Symposium of ICECHIM were scientific actions and meeting events for Romanian and foreign researchers to change and disseminate scientific information and to establish contacts for future collaboration.

Other significant aspects

Our team recruited three new members: three PhD researchers in chemistry, biochemistry and biotechnology and two young university graduate chemists. It participated with two researchers at training courses for high specialization and certification as Experts accessing EU structural funds and cohesion, and also it is training three PhD students to be specialized in the research domains of advanced methods of obtaining oils from renewable natural resources, modernization / improvement of the technologies for conversion of by-products from biofuels manufacture. All the R&D data obtained within the direct contracts was transferred as novel, modernized or improved technologies to the beneficiary SC Olchim Rm-Valcea SA to be built on an industrial scale and to enhance the competitiveness of the company.

Quantitative approach

For the period 2007-2011, the main indicators of the team R&D activities are:

- Direct research contracts : 6 contracts with beneficiary SC Oltchim Rm.-Valcea (550.000 RON + VAT)
- Budget founded contracts: 11 contracts (2079308 RON)
- Articles in ISI Papers: 8 (6 published and 2 submitted)
- Articles in non-ISI Papers: 7
- 1 book and 2 book chapters about fertilizers
- 40 scientific communications at national conferences and 25 international events
- 4 project proposals for PCCA 2011(2 of them with ICECHIM=Coordinator of the Project)
- 1 Manunet 2011 Bilateral project RO/Spain accepted for funding starting with 2012 (ICECHIM=Coordinator of the Project)
- Patents: 11 OSIM patents, 2 international patents, 35 OSIM patent applications to protect the intellectual property on the novel microbial agrouseful strains, (bio)products and technological processes of obtaining the same.

As illustrated in the next figures, the most important number of patent applications resulted after the best financially sustained period (2008-2009) from the PNCDI projects. Thus, as an indisputable evidence of achieving the national project objectives, from the R&D activities resulted 7 patent applications in the year 2007, 6 in 2008, increasing to 12 in 2009, recording the best results with 18 patent applications in 2010, and decreasing to 5 patents applications in 2011. Among these, OSIM granted a number of 4 patents in 2009, 2 patents in 2010 and 5 patents in 2011, the remaining ones being in present within the evaluation process.

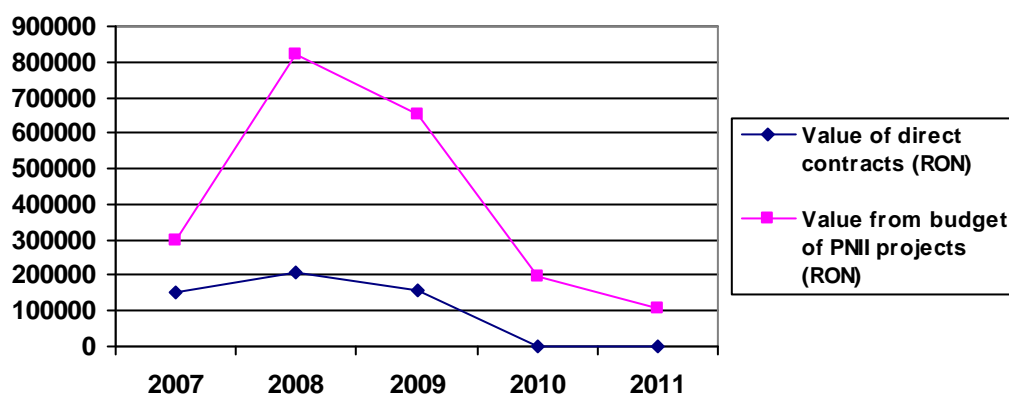


Figure 1. Evolution of financial resources attracted by team members through direct contracts and from the state budget through national projects other than “Sectorial” and “Nucleu”

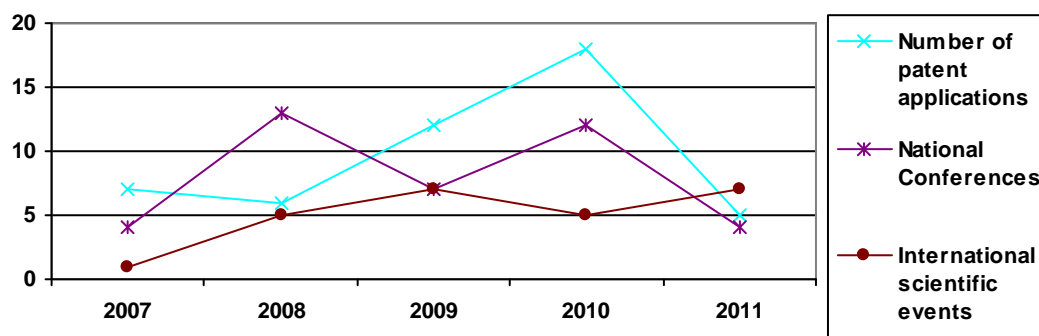


Figure 2. Dynamic of the dissemination actions and patent applications resulted from R&D activities of national projects

E 5: BIOFUELS AND FUEL ADDITIVES (BFA)

Concerns about the depletion of fossil fuel reserves, the impact of anthropogenic CO₂ emissions, and increasing energy demands have encouraged our research team in exploration of new methods for converting biomass into sustainable platform renewable fuel components.

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009, on the promotion of the use of energy from renewable sources, aims at achieving by 2020 a 20% share of energy from renewable sources in the EU's final consumption of energy and a 10% share of energy from renewable source in each member state's transport energy consumption.

In this favorable context, the last four years research of Biofuels and fuel additives (BFA) team was focused on biomass processing by production and "upgrading" of chemical entities in order to be used as biofuels and fuel additives, having a strong applicative nature. In the BFA research team composition, average age are 44 years, 50% are members younger than 35 years, 12.5% are PhD, and 37.5% are PhD students.

Component of the BFA team: Stepan Emil – PhD, CS1 (leader team), Dobre Elena - CS1, Radu Adrian CS3, Enascuta Cristina Emanuela – CS, PhD student, Oprescu Elena Emilia - CS, PhD student, Capra Luiza – CS, Faraon Alexandru Victor – ACS, PhD student, Frunza Elena – technician.

Interdisciplinary profile of BFA team allows to carry out applied research in chemistry field and organic chemistry technologies (unpetrochemical products, organic intermediary, complex biomass refinery), unconventional technologies, ecological technologies and products, chemical and instrumental analysis, technological transfer, consulting, management and execution of national and international research projects.

Since 2007, BFA team coordinated 2 RD projects and was involved in other 5 as partner.

In this time increased visibility of BFA team by promotion and better dissemination of results. Members of his team published 9 scientific papers in ISI journals, 13 scientific papers in non-ISI journals, registered 5 patents and 12 patent applications, and presented 19 communications at international symposia / conferences.

Most important achievements:

The last four years, BFA team performed and finalized the following national / international projects:

1. "Complex exploitation of some renewable natural resources to obtain biofuels, glycerine and ecological solvents" - CEEEX 2-2005 (BIOTECH), (2005-2008)

Research team was composed of 8 partners (2 of them being small and medium enterprise). ICECHIM was Project coordinator and Stepan Emil - Project manager

Research was directed towards manufacturing 3 classes of products in large quantities, with a strong economic, social and environmental impact, namely: diesel biofuel, ecological solvents, glycerin and towards the investigation of the source of raw materials, the oleaginous plants. The alternative solvents and fuels that will be synthesized and purified will have similar properties with the classic ones, but will be *environment-friendly* products. Purified glycerin falls under the same category of products.

ICECHIM BFA team was developed 2 new technologies, for obtaining 2 new products: diesel biofuel and eco-friendly solvent. Was elaborated 2 patents, was published a paper and 6 scientific communications.

2. "Technologies for green chemistry products, from fat matters" - PN II 31 064-2007, (2007-2010)

Research team was composed of 4 partners (1 of them being small enterprise). ICECHIM was Project coordinator and Stepan Emil - Project manager

Our work was focused on simultaneous production of biodiesel, glycerin, and surfactants (mono- and diglycerides) based on alcoholysis of vegetable oils, using organic base like catalysts. A few catalysts were evaluated concerning their efficiency in obtaining mono- and diglycerides. Different separation techniques were used in the complex system: fatty acid methyl ester / mono- / di- / triglyceride / glycerin.

ICECHIM BFA team was developed 2 new technologies. Was elaborated 1 patent, was published a paper and 3 scientific communications: 2 national communications and 1 international communication (2nd EUCHEMS Chemistry Congress, Turin, Italy)

3. "Biofertilizers and growth stimulators for sustainable culture of plants, with additives obtained by bio-refining of proteic by-products" - CEEEX 252-2006, (2006-2008)

ICECHIM was Project partner and Stepan Emil - Project responsible

ICECHIM BFA team elaborated new technologies for biodiesel, biofuel for heating and protein hydrolysed, from leather waste. Were made 2 patents, was published 2 scientific papers and 2 international communications (CESIO - 7th World Surfactants Congress, Paris, France; XXIX Congress of the International Union of Leader Technologists and Chemists Societies (IULTCS), Washington, D.C. USA).

4. “Transesterification of triglycerides in heterogeneous catalysis assisted by unconventional energies: ultrasonic and microwave” - CEEEX 707-2006, (2006-2008)

ICECHIM was Project partner and Stepan Emil - Project responsible

ICECHIM BFA team elaborated new technologies for valorization of crude glycerin obtained as by-product from biodiesel in heterogeneous catalysis production. Research was focused on glycerol derivatization to obtain acetals / ketals, in order to be used as biofuels and fuel additives.

5. “New microorganisms capable of enzymatic synthesis of active therapeutic biopolymers, using glycerin (by-product of biodiesel obtaining)” - PN II 61 006-2007, Stepan Emil – Project responsible (2007-2010)

ICECHIM was Project partner and Stepan Emil - Project responsible

ICECHIM BFA team realized a new technology for purifying of crude glycerin obtained as by-product from biodiesel fabrication, using a variety of raw fat materials and catalysts. Results were presented as a communication at a national conference.

6. „Biodegradable coolant and lubricating fluid with multiple function” - PN II 32 104-2008, (2008-2011)

ICECHIM was Project partner and Stepan Emil - Project responsible

ICECHIM BFA team developed a new technology for obtaining antioxidant, anti-wear and extreme pressure additives for biolubricants.

Research results were disseminated by 1 patent, a national communication and an international communication (World Tribology Congress 2009, Kyoto, Japan).

7. “Advanced materials obtained by using high tech processing of leather by products”, Bilateral Cooperation Romania – Turkey, between National R&D Institute for Textile & Leather and Ege University Izmir, (2008-2009).

ICECHIM was Project partner and Stepan Emil - Project responsible.

Project was focused on valorization of leather by-products to obtain biofuels, collagen and protein hydrolysed and was finalized for us, as two communications presented at Ist International Leather Engineering Symposium “Leather Industry-Environment and Progressive Technologies”, Izmir, Turkey.

Dynamic research topics and directions

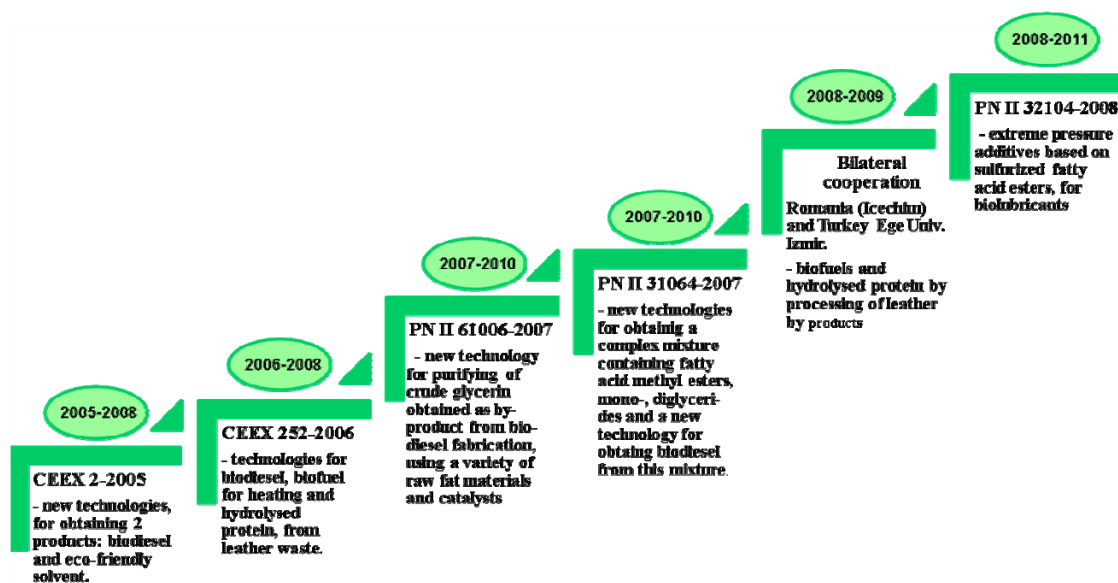


Figure 1. Dynamic of national / international projects

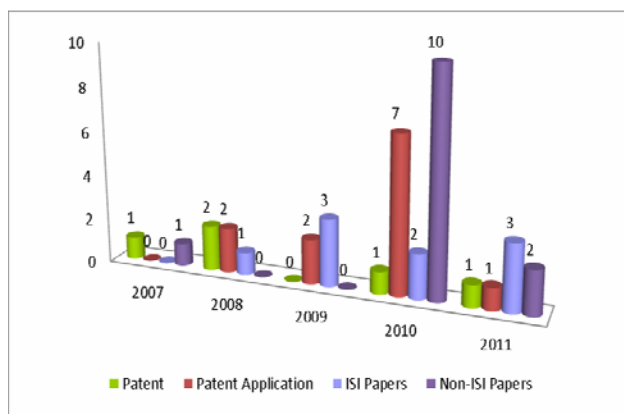


Figure 2. Dynamic of scientific publications

Interdisciplinary and entrepreneurial initiatives

Research team has interdisciplinary profile with members having academic studies and specializations in the field of chemistry, chemical engineering, chemical and instrumental analysis, management of national and international research projects

Human resources evolution

Valuing interests in raw materials from renewable resources began for BFA team in the 90s, being focused on fats processing to obtain biodiesel and anhydrous fatty acid salts.

In the structure of ICECHIM, Bioresources Laboratory was created in 2004, consisting of 2 researchers. Laboratory increased in time by employing new young research assistants. The research assistants were stimulated to promote scientific researcher (3 people) and to attend PhD studies (3 people). In 2008 Bioresources Laboratory was upgraded to Bioresources Department, based on project “Development of Bioresources Department by upgrading the Research & Development infrastructure (BIORES)”, founded by government of Romania by ANCS, CAPACITIES Program. In this department there is “Biofuels and fuel additives” team, composed of 7 scientific researchers; one has PhD degree and three are PhD students.

Other significant aspects for scientific development of the team:

Some patents developed by BFA research team were presented at international exhibitions of inventions being awarded medals:

- **Stepan, E.,** Serban, S., Velea, S., Lata, I., “Diesel biofuel and process for obtaining the same”, *RO Patent 121,913* - EUREKA INNOVA Energy Exhibition, Brussels, November 24th, 2007, **Gold Medal with mention**; INVENTIKA-International Exhibition of Inventions, Scientific Research and New Technologies, Bucharest, October 2-6, 2007, **Gold Medal**
- **Stepan, E.,** Serban, S. Velea, S., “Ecological solvent and process for preparing the same”, *RO Patent 121,859* - 35^e Salon International des Inventions des techniques et produits nouveaux, Geneve 18-22 avril 2007, **Gold Medal** and **IFIA ECO PRIZE, 2007**;
- **Stepan, E.,** Velea, S., Serban, S., “Process for obtaining of diesel biofuel from wastes”, *RO Patent 123,178* - INVENTIKA-International Exhibition of Inventions, Scientific Research and New Technologies, Bucharest, October 7-10, 2008, **Gold Medal** and **Special Prize of OSIM**
- Velea, S., **Stepan, E.,** “Process and photobioreactor for carbon dioxide biofixation, from greenhouse gases” *RO Patent Applications A00288-2009* [INVENTIKA-International Exhibition of Inventions, Scientific Research and New Technologies, Bucharest, October 28-31, 2009, **Gold Medal**
- **Stepan, E.,** Velea S., Tanase, C., Radu, A., Enascuta, C. E., Oprescu E. E., „Process for obtaining a diesel biofuel and tensides from fatty material”, *RO Patent Application 126,669* - INVENTIKA-International Exhibition of Inventions, Scientific Research and New Technologies, Bucharest, October 6-9, 2010, **Gold Medal**
- Gaidau, C., Filipescu, L., **Stepan, E.,** Ghiga, M. D., „Composition of protein additives for nutrition, stimulation, plant protection and process for preparation of it.”, *RO Patent 123,026* - INVENTIKA-International Exhibition of Inventions, Scientific Research and New Technologies, Bucharest, October 5-8, 2011, **Gold Medal, Diploma AROTT,** and **Special Prize of OSIM.**

E 6: BIOTECHNOLOGY AND BIOANALYSIS (B&B)

The **Biotechnology and Bioanalysis (B&B)** team is an *interdisciplinary* one like the field itself. The Biotechnology group exists in ICECHIM structure since its far beginnings and during the time was focused on following main research directions: **environmental biotechnology**, **human healthcare biotechnology** and **bioanalytical methods** for fast monitoring and control of the environment and food quality (see the scheme below).

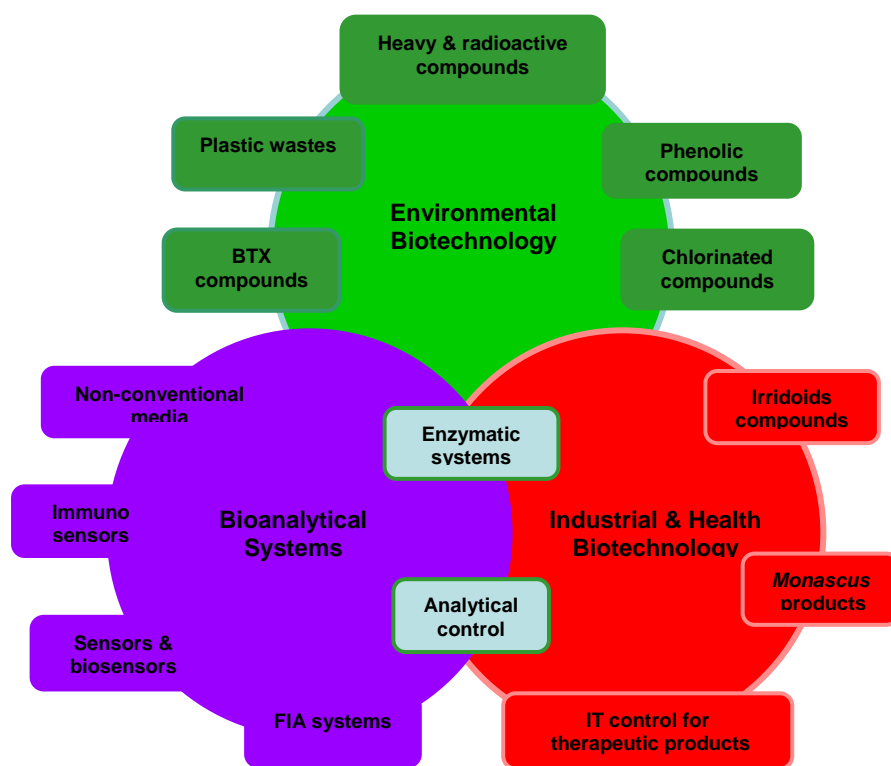


Fig. 1. Schematic representation of the R&D directions of B&B team

An important achievement was the modernization of RD infrastructure by the financial support of National Authority for Scientific Research, through the **CAPACITIES project CP 49/2007 "Biotechnology & Bioanalysis Laboratory"** coordinated by our group. The four modernized laboratories according to the GLP (Good Laboratory Practice) rules are: Microbiology Lab, Separation Lab, Optical Methods Lab and Biosensors Lab.

The main RD directions with the projects and the main achievements since 2007 are described below.

1. Environmental biotechnology

Environmental biotechnology may offer solutions for elimination of a wide range of pollutants and wastes from the environment. For this reason, in our Microbiology Laboratory was initiated a microbial collection as a starting point for the future modern collection, according to the international requirements. In last years, this research direction was deepened by our team, which has coordinated three projects in partnership with prestigious research units:

Project CEEX 127/2006-2008 "Advanced solutions for reducing of the volatile organic compounds content in surface and underground waters" has realized an integrate system to remove the volatile organic compounds from ground and surface waters, combining the advantages of extraction with liquid membranes and bioremediation. Results: 3 published papers; 2 participations at International Conferences.

Project PNCDI II no. 61-045/2007-2010 "Biocontrol methodology development of microbial systems against fungal contamination (BIOCONTROL)" was conceived to develop biotechnologies having an impact towards life quality. Results: 1 patent application; 5 published papers; 6 participations at International Conferences.

Also, B&B team deserved the other groups especially in research activities involving microbiology and biochemical techniques. During 2007-2011, B&B group has coordinated 7 RD projects and was involved in other 4 as partner. The work of team was focused towards the elaboration of scientific papers for publishing and presentation of works at national / international conferences, through research projects within the framework of national R&D programs.

Project PNCDI II no. 32-115/2008-2011 “Eco-efficiency solutions for plastics waste management using degradative potential of biological systems” (ECODEGRAD) investigates the aerobic biodegradability of composites based on a synthetic and biodegradable polymer and natural polymeric materials. Several microbial strains were selected for their capacity to grow and degrade polymeric materials. Results: 2 published papers, 6 participations at International Conferences, 1 patent request. In 2011, the paper “Ability of fungal strains to degrade PVA based materials” published in *Journal of Polymers and the Environment*, 2010, vol. 18, 284-290 was awarded by CNCSIS.

2. Human healthcare and industrial biotechnology

Several bioproducts with therapeutic effects were obtained within research projects, such as project **CEEX 177/2006-2008** “Therapeutic Nano products based on irridoids compounds isolated from Romanian vegetable species”, **project PN II 62-081/2008-2011** “Algorithms for the multicriteria decision and intelligent control of the biotechnologies for the preparation of therapeutic products of human use”, **project PN II 62-070/2008-2011** “Concept and development of innovative biotechnologies for preparation of nano products from *Monascus sp.* with potential therapeutic applications”). Results: 10 published papers, 1 book and 8 participations at International Conferences. Due to the increasing interest in the **replacement fossil fuels with renewable energy**, our team was also involved in production of microbial enzymes used as catalyst in transesterification, in framework of the project **PNCDI II 61-032/2007-2010** “Development of biocatalytic systems for the vegetable oils transesterification to biodiesel. Results: 3 papers, 1 book chapter and participations at 3 international conferences.

3. Bioanalytical methods for fast monitoring and control of the environment and food quality.

Another important research direction of our team consists in the development of bioanalytical methods for screening / fast detection of the food contaminants as **nitrite / nitrate, heavy metals, antibiotics, pesticides** (project **CEEX 68/2006-2008** “Innovative systems for fast detection of contaminants in drinks and foodsuffs”). The developed methods are based mainly on the flow injection analysis (FIA) technique using the luminescence (chemiluminescence and fluorescence) detections, as well as the electrochemical detection. Results: 2 published papers, 1 book and 6 works presented at international conferences.

For **mycotoxins** determination (project **PNCDI II no. 61-030/2007-2010** “Fast methods for toxins monitoring during food processing technologies for safety improvement”) complementary methods based on immunosensors sensors, flow analysis and HPLC were developed. Also, the project aimed to develop new immunosensors based on surface plasmon resonance using new strategies for modification of the SPR sensor surface. Results: 3 papers; 1 patent request; 7 works presented at international conferences.

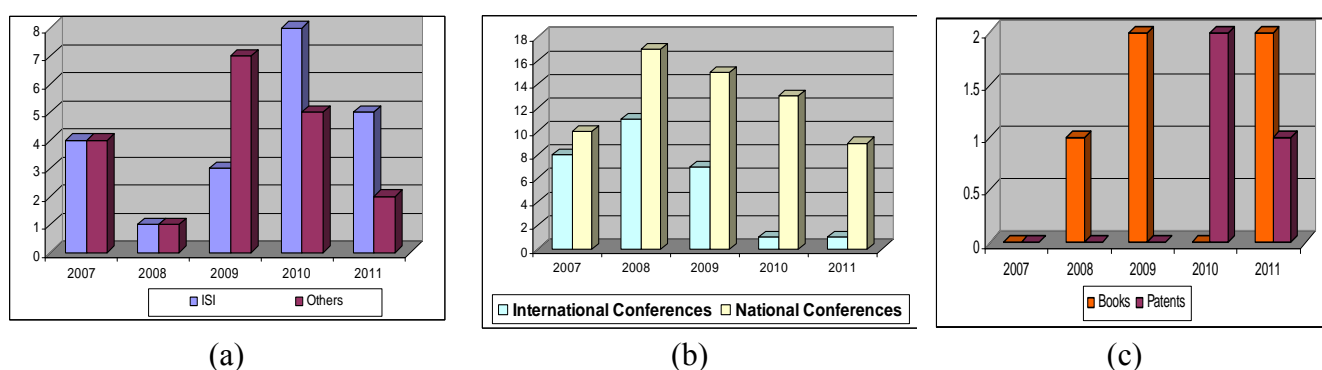


Fig. 2. Dynamic of the scientific results of B&B team. (a.) ISI papers and other (non-ISI) papers; (b) works presented to International and National Conference; (c) books and patents.

The dynamic of the scientific results achieved by the B&B team in terms of ISI papers, other papers published in peer-reviewed journals, works presented to international and national conferences, books and patent requests is presented in the figure 2.

Collaborations

B&B team collaborates with numerous prestigious **research units** from Romania such as: University Polytechnic of Bucharest, University of Bucharest, Biochemistry Institute and Biology Institute of the

Romanian Academy, Institute for Physical-Chemistry „Ilie Murgulescu”, National R&D Institute for Biological Sciences, Cantacuzino Institute, University of Agriculture Science and Veterinary Medicine of Bucharest, etc. In the *healthcare biotechnology* research area, our traditional collaborators are **hospitals**, such as: Hospital „Carol Davila”, Medical Clinique „I.C.Longhin”, Clinique RomGermed, Children Hospital „Grigore Alexandrescu”.

Regarding the collaboration with **SMEs**, in the field of *environmental biotechnology*, one of the most important collaborator and co-funding companies is SC INCERPLAST SA, which is a private SME company whose main activities are in the field of processing polymeric materials with applications in medicine, industry, agriculture, packaging, environmental protection, etc. Our team has successfully collaborated with this company in two PNCDI II projects and also a new joint proposal was submitted in the „2011-Competition of the Joint Applied Research Projects Program”.

S.C. EPI-SISTEM S.R.L. is another company with which we have a strong collaboration in the field of development of new *electrochemical and optical biosensors and immunosensors*. In the most recent competition, was submitted a project based on a consortium coordinated by our team, in which EPI-SISTEM will co-fund almost all the RD activities.

Evolution of human resources

The B&B team lead by Dr. Luiza Jecu is an interdisciplinary group, which consists of **10 researchers** (four biochemists, one chemist, three engineers and two microbiologists) from which **five have Ph.D.** degree and **three are Ph.D. students**. Since 2007 our group supported some important transformations due to the retirement or transferring of several persons, among them, CS III Dr. Amalia Gheorghe and CS Dr. Camelia Ungureanu. A great attention was paid to the recruitment of young and enthusiastic researchers like Emilia Ocnaru, Alexandru Chivulescu, Iuliana Raut and more recently, Mariana Constantin. A prerequisite condition for employing them was to continue their studies and in consequence, the first three are doing their Ph.D. studies in our institution (under the supervision of University of Bucharest). In 2009, they have successfully passed the exam to obtain the *scientific researcher* title.

Also, it can be mentioned that even before 2007 in our team was reintegrated Dr Mihaela (Badea) DONI after a Mare Curie postdoctoral stage (18 months) and 24 months postdoc position abroad (Tor Vergata University, Rome, Italy), where she gained expertise in development of innovative bioanalytical systems. Due to her expertise, Dr. Doni was invited to be *national evaluator expert* for national RD Projects (CNCSIS, CEEX, PNCDI); *reviewer for scientific journals*, *EU evaluator expert* in FP7-PEOPLE-2010-IXF and PEOPLE-2011-IXF Programs.

In our group, all the other experienced researchers (Dr. Maria-Luiza JECU, Dr. Ana Aurelia CHIRVASE, Dr. Melania-Liliana ARSENE, Dr. Nicoleta RADU) have *conducted national RD projects*, were invited to be *evaluator experts* for national RD Projects and *reviewers* for scientific journals, were *members in the Ph.D. thesis commissions*, etc.

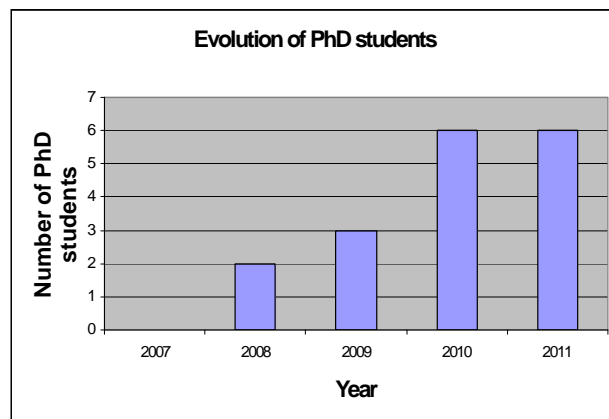
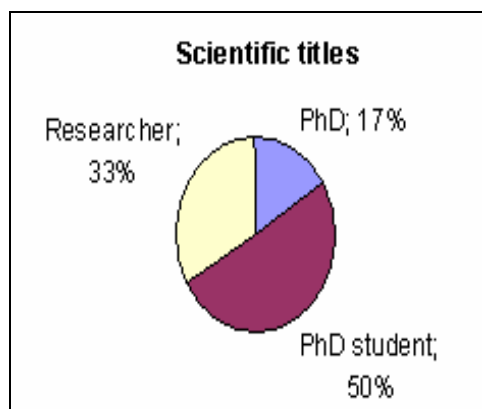
A significant attention was given to the **continuing vocational training** of B&B team's members in the specific scientific areas and in other important areas, such as the project management, by participation to various courses and seminars. Several of these courses were completed with exams and diplomas recognized by CNFPA, as evidence of the level of expertise achieved.

Other aspects

- The B&B team has supervised and hosted **students for practical stages** from local Universities, as well as from University of Bristol, UK. Also, Dr. Jecu, Dr. Arsene, Dr. Doni and Dr. Chirvase have **co-supervised** several MSc, BSc and PhD thesis.
- Dr. Arsene and Dr. Chirvase are **collaborating as professors** with the Biotechnology Master from University POLITEHNICA Bucharest, Department of Bioengineering and Biotechnology, by teaching various courses.
- In 2010, B&B team submitted as partner the proposal no. EIB.10.009, entitled “*Bioresource-using technologies for a high-yield and high-rate synthesis of hydroxybutyrolactones from renewable carbon (BUTYROLAC)*”, in frame of the **ERA-IB call**, which passed the first step (pre-proposal).
- The B&B senior researchers are founder members of the **Romanian Society for Bioengineering and Biotechnology (RSBB)** (president Dr. Eng. Ana-Aurelia Chirvase), affiliated to EFB (European Federation of Biotechnology).

E 7: COLLOIDS AND SURFACES. INDUSTRIAL AND ENVIRONMENTAL APPLICATIONS.

Team consists of **11 researchers**- two senior researchers first degree, two senior researchers second degree, three researcher third degree, three researchers, one researcher assistant and 5 technicians.



Description of the research domain

The research domains of the team refer to:

- Surfactants-new types, technology development, studies on surface activity of new types of surfactants and applied colloidal chemistry for industrial applications-metal working, nuclear power plant;
- Interdisciplinary research in the field of valorization of natural resources and industrial waste remediation technologies and the development of industrial gas and liquid streams decontamination - through mesoporous materials obtained by surface modification of natural zeolites;
- Valorization of bio renewable raw materials for obtaining additives and bio refinery products.

The activity in the last four years of the research team turned to the shift from classical technologies based on fossil raw materials processing, to the principles of green chemistry including the use of renewable raw materials. Applied research in this direction has an interdisciplinary character and environmental application:



The **main objectives** of team research activities were:

New technologies for manufacturing surfactants:

- Use of renewable raw materials to the manufacture of surfactants.

Studies on surface activity of new types of surfactants and applied colloidal chemistry:

- Surfactants based colloidal systems without negative impact on the environment, used for machining metal surfaces;
- Protect the environment by radioactive liquid waste conditioning;
- Preparation of peptide surfactants results in the valorization of protein waste.

Interdisciplinary research in the field of valorization of natural resources and industrial waste remediation technologies and the development of industrial gas and liquid streams decontamination:

- Development of the type Me-ZN catalysts (Me = Cu, Co, Mn, ZN = natural zeolite) by adsorption processes and / or ion exchange, catalysts effective for environmental applications: removal of VOCs, NO_x from industrial gas streams;
- Mesoporous obtaining materials (tailored) by functionalization of natural zeolites with organic compounds (quaternary ammonium salts, alkyl amines, oxygenates). The new structures with specific characteristics can be used in gas separation, purification of water with high content of hydrocarbons, dyes, oxyanions;
- Obtaining natural zeolites of different mineral deposits (with variable content of clinoptilolite) and industrial waste (red mud, an aluminum industry waste). New textural features by chemical and / or unconventional procedures;
- Obtaining natural zeolite-based composite with lamellar compounds of type hydrotalcites or modified red mud adsorbent properties and mechanical strength and heat; Remediation of waste water by physicochemical treatments (adsorption, ion exchange, flocculation, filtration);

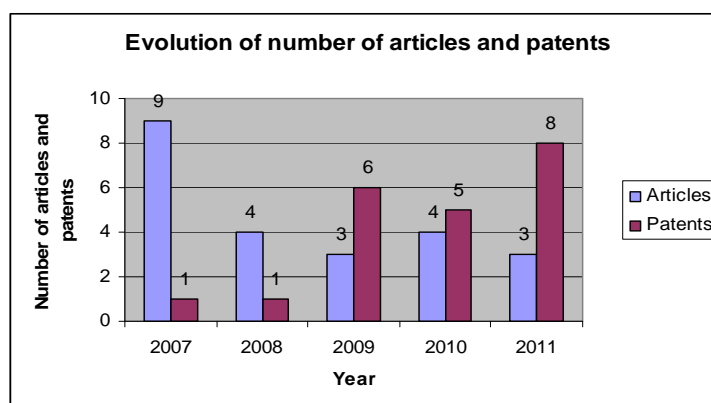
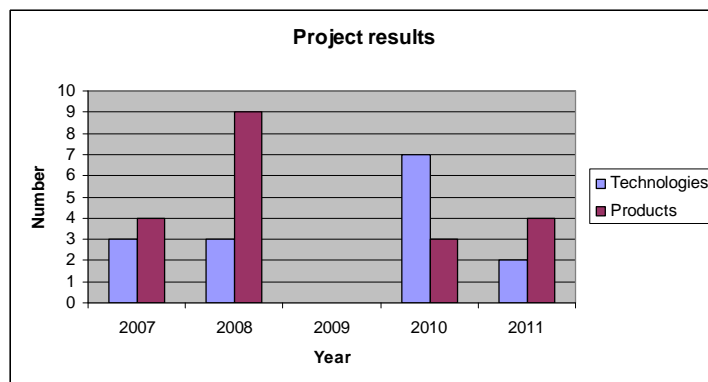
Valorization of bio renewable raw materials for obtaining additives and bio refinery products:

- New procedures for valorization of glycerol obtained in biodiesel synthesis;
- Glycerol valorization for obtaining non pollutants fuels and anti freezing additives;
- Hydrogen obtaining from bio renewable sources.

Analysis and evaluation:

- Development and accreditation of a laboratory for analysis of emissions from waste incineration process according to EU Directives transposed in GD. 128/2002.;
- Making the physical-chemical and detergent performance evaluation.

Major achievements:

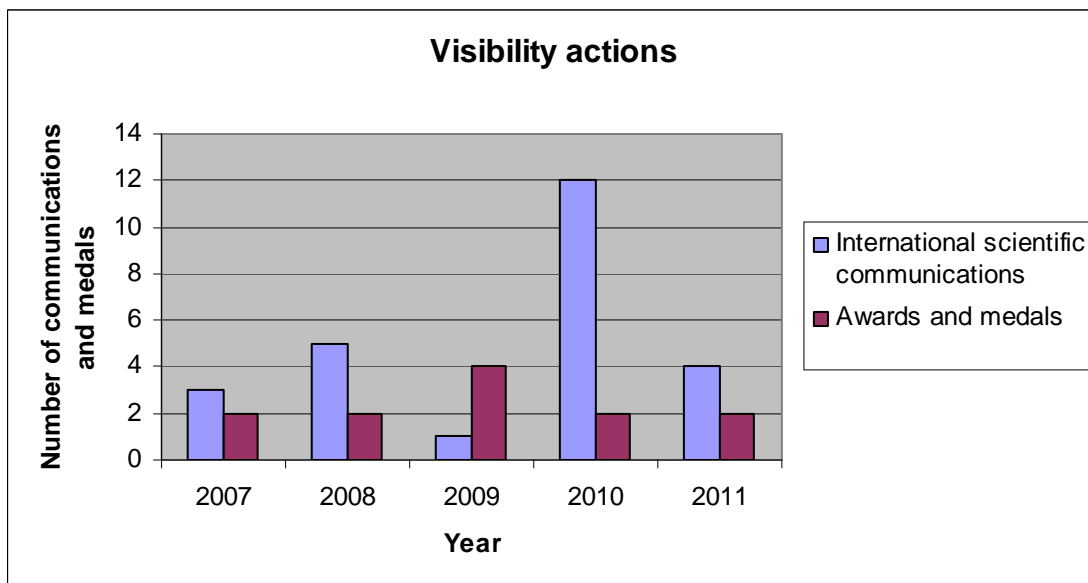


At the request of the Ministry of Economy in 2008-2010 was elaborated a prospective study on *"Refining and petrochemicals industry-present and perspectives. Strategic elements for increasing competitiveness"*.

Strategic partnerships:

- PhD. Dimiter Balabanski senior researcher first degree at Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria. He is partner in strategic cross border project "Integrated Management Danube WATER (WATER).
- PhD Joachim Sanchez Leal- senior researcher first degree, member of Comitee Espanol de la Detergencia y Afines, Barcelona, Spain, a recognized expert in the field of surfactants.

Visibility actions:



Other significant aspects

- Experience and results in radioactive waste management led to the **Romania-Bulgaria cross border project "Integrated Management Danube WATER (WATER)"**, selected for funding in May 2011. In this project ICECHIM, RAAN-SCN, UPB and Institute of Nuclear Physics, Bulgaria will develop technologies for decontamination and conditioning of liquid waste resulted from the Cernavoda and Kozloduy nuclear power plants. The project is funded 84% of European funds ERDF. The project is in pre contracting phase.
- Experience and results of the research in the field of removal of radionuclides on emulsion liquid membranes are based on a **PhD thesis** author Irina Chican, the sentence in which the novelty consist in selection of an oil waste transporter.

E 8: ECO – FRIENDLY MATERIALS

Team description

The team consists in specialists in the development of new polymeric materials (including bio - nano-hybrides) considering synthesis methods and melt processing procedures.

The results are certified by the number of patents and ISI coated articles, new technologies and new products, obtained or realized over the years including the analyzed period, all with the main authors / project manager the team leader.

Fields of interest

- Eco-friendly multifunctional materials for eco – friendly applications;
- Micro-encapsulation;
- Hydrogels for tissular regeneration

Achievements

- Publication of about. 4 articles each year (2007 – 2011) (Fig.1)
- Patents and patents application with an average by 2.2 patent - patent application / year (Fig.1)
- Books / chapter in books : 1 book to be published at Politehnica Press – UPB
 1 chapter in a book

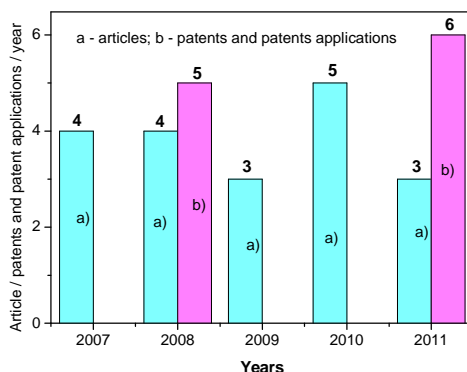


Fig.1

The dynamic of the research subject and directions

- The main research area that the team approached was the study and the realization of eco-friendly materials for various eco-friendly applications, namely:
- Materials with barrier properties for eco-friendly food packaging;
- Hydro-soluble materials for eco -friendly packaging;
- Biodegradable materials, including foam-type, for eco-friendly packaging;
- Materials with antimicrobial properties for eco-friendly food packaging;
- Materials for corrosion, anti-vibrational and anti-abrasive protection of the for metal surfaces;
- Sustainable materials for runways in road constructions.

In 2008 the team approached two new applications directions of new eco -friendly materials of great scientific and practical interest, in which significant results were obtained:

- Biodegradable and biocompatible materials for tissue reconstruction (hydrogels for adipose and cartilaginous tissue regeneration);
- Microencapsulation of some reactants used in soil decontamination polluted with petroleum products.

Based on the obtained results the team has decided to maintain and develop all the three described research directions. The main results obtained in the last period is summarized in table 1

Table 1 Main projects and the scientific results with the specification of the way in which the results are disseminated (2007 – 2011)

Project	Articles ISI quoted / Symposium (in accordance with the CV and the main results list)	Technology / Product / Patent
<p>A. International projects 2006 - 2008 Eureka E! 3523 – “Plastics recycling technology using the re-melting and re-stabilization method” / Project manager / project type EUREKA</p>	<p>Chapter in book: Doina Dimonie et al., “Recycling – book 1 - chapter. “Overview on POSTC-PET recycling by chain extension”, ISBN 979-953-307-329-2, InTech open access publisher Croatia</p>	<p>Technology for recovery of POSTC-PET</p>
<p>B. National projects -“ Foam eco - friendly packages based on biodegradable renewable polymers”, 2008 –2011 /Project manager / project type PN II /2008</p>	<p>- D.Dimonie et al., Journal of Nanomaterials, Volume 2008, Article ID 538421, 7 pages, doi:10.1155/2008/538421 “The dependence of the XRD Morphology of some bionanocomposites on the silicate treatment” - D.Dimonie et al., Polymers 2011, 09, ISSN 1618-7229, www.e-polymer.org - MATERIALE PLASTICE, 47 (4), pp. 486-491, 2010; - D.Dimonie et al., Revue Roumaine de Chimie, 2011, 56(7), 685 – 690; - D.Dimonie et al., Proceeding of 16th Romanian International Conference on Chemistry and Chemical Engineering, Sinaia, September 9-12, 2009, Ed. Printech,2009, ISBN 978-606-521-349-4 - D.Dimonie et al., Proceeding of International Conference of the South Eastern Countries Chemical Societies September - ICOSECS7 – 7TH, 15 – 17, 2010, Bucharest – Romania, ISBN 978-973-748-512-0;</p>	<p>New technology for obtaining eco –friendly new foamed packages New products: granules based on starch and polymeric foams based on starch for eco – friendly packages Patent application 2011</p>
<p>“New concepts and strategies for developing new knowledge of biocompatible structures in bioengineering” /2010 – 2013 / Project responsible / Project type : Exploratory research complex ideas</p>	<p>Doina Dimonie et al., “New alginate hydrogels with controlled gelling time, morphology and properties for soft tissue regeneration”, under publication at BMC Biotechnology (journal with 2,86 impact factor).</p>	<p>New hydrogel type Patent application 2011 no.A/01263 / 29.11.2011</p>

List of ongoing projects

- "Cellular biodegradable ecological packaging based on renewable polymer" / contract no.32101 / 2008 – 2011 / **Doina Dimonie**

- “Development and modernization of food films based on biopolymers and natural microbial agents to increase food security” / contract no.52134 /2008 – 2011 /**Liliana Anton**
- “New concepts and strategies for developing new knowledge of biocompatible structures in bioengineering” /contract no. 248/2010 – 2013 /**Doina Dimonie**
- “Oxidizing and reducing microencapsulation of substances for cleansing soil” / contract FP 7 226956 / sub-contracting by ICECHIM / 2010 – 2011 / **Doina Dimonie**
- “Plastics recycling technology using the re-melting and re-stabilization method” /Eureka E!3523, 2008 / **Doina Dimonie**

The evolution of the human resources

In our group, young people were always involved. Even though some have left the team (one to work in University and another in Spain) others were immediately hired. Recently was hired a young graduate in 2011. Improving the professional level was always an objective and was performed especially by youth participation in master and doctoral studies. During 2007 - 2011 were presented two doctoral theses, with subjects related to the scientific activity performed by the team. For an internship at a University in Europe for the young doctoral student that presented its dissertation in 2011 (POST-DRU programme) following three possibilities were established:

- Pissa University, Italy, Prof. Camino;
- University of Strasbourg, France, Prof. Luc Averous.
- University of Patras, Greece, Dr. George Papanicolaou.

In our group, students had conducted research internships including for the elaboration of their graduation thesis. There are requests for research internships from foreign students. Solving the legal formalities for accepting these young students in ICECHIM is required.

Young people are trained continuously in dissemination activities of the team. All presentations at conferences are held only by young people.

Other aspects for the scientific development of the research team

For cooperation related to studying and carrying out different eco – friendly materials the team has received the agreement from the following professors:

- Prof. Fillipe Philippe DUBOIS from Universite de Mons-Hainaut UMH, Center of Innovation and Research in Materials & Polymers CIRMAP,
- Prof. Luc Averous, Université de Strasbourg, Ecole Européenne de Chimie, Polymères et Matériaux

These agreements will be used in the future approaches of the team.

Visibility – Between 2007 – 2011, Dr. Doina Dimonie-the team leader:

- Was reviewer at Polymer International, Journal of Polymer Research, Materials Chemistry and Physics
- Has received Gold medal at “INVENTIKA”, 2008, Bucharest, for patent Ro no.121692
- Has received Bronze medal at “INVENTIKA“ 2011, Bucharest, for patent application no .00560/21.07.2008, decision Ro. no.3/112
- Was expert valuator at RELANSIN, CEEX, PNCD II, PNCD II – “Capacitati” research programs
- Has supervised the PhD thesis “Multifunctional new materials based on starch” (UPB- 2011).

E9: HETEROGENEOUS SYSTEMS

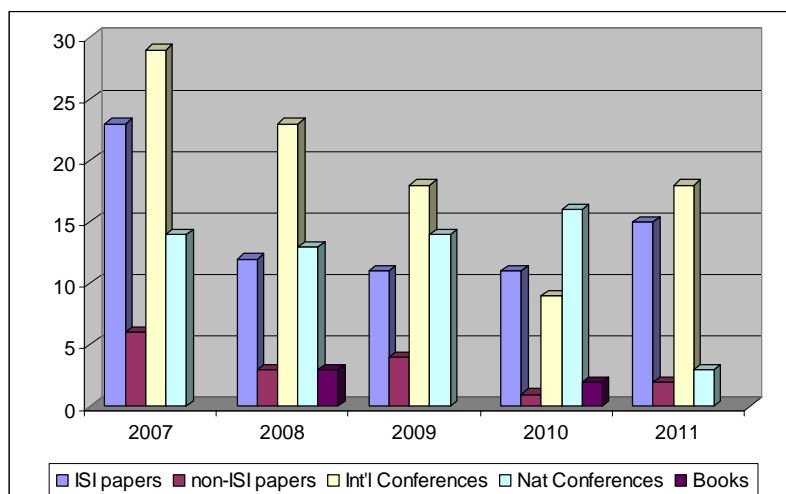
The “Heterogeneous systems” team, lead by Dr. CSI Dan Donescu, is formed by 7 researchers with PhD title, 1 PhD student, 1 assistant researcher and 2 technicians.

R&D directions.

- Polymer-inorganic hybrids obtained by sol-gel process and/or melting intercalation processing;
- Polymer-inorganic functional nanoparticles obtained in disperse media;
- Hybrid nanocomposites obtained by Layer-by-Layer polyelectrolyte deposition;
- Polymeric nanoparticles and thin films for biomedical applications
- Hybrid magnetic-polymer nanoparticles for drug delivery systems and biosensors;
- Emulsion and microemulsion polymerization with functional monomers;
- Multifunctional polymer electrolytes;
- Core-shell micro- and nanoparticles;
- Customer designed synthesis for new biocompatible polymers;
- Micro- and nanoparticles with controlled properties;
- Specific, high technology, analyses and characterizations for polymer nanoparticles.

Major Results

- ISI papers: **72** (summarizing $FI_{total} = 79,817$ and $AIS_{total} = 52,056$) of which, **11** in collaboration with international teams (a complete list could be provide by request);
- Non-ISI papers: **14**;
- International communications: **89**;
- National communications: **52**;
- Books and international book chapters: **5**;
- National Patents: **1**;
- External collaborations – submitted EU proposals: **8**.
- PhD thesis: **7**;
- Training stages in European labs.: **10**;
- Postdoctoral fellows: **4**;
- Young graduates hired: **8**



New area of research explored. Polymer nanohybrids with application in medicine, with magnetic nanoparticles and biopolymers used for drug encapsulation, with silver (Ag) nanoparticles with anti-bacterial properties, with carbon nanowires for electromagnetic shielding, radiation insulating foams.

Entrepreneurship initiatives. Due to the slow development of the national economy interested only in few areas in applying new researches, it was managed to integrate into international consortium.

HARCANA project has developed research for obtaining polymer materials or to use carbon nanotubes for automotive industry and polymer foams for screens against electromagnetic radiations.

Projects coordinated by “Heterogeneous Systems” team:

International:

No.	Type	Name	Period
1.	FP7- Large	High Aspect Ratio Carbon-based Nanocomposites – HARCANA	2008-2012
2.	FP6-SSA	Enhancement the Quality Participation at FP6 Projects in the Polymer Nanomaterials Field – ENPONA	2005-2008
3.	Bilateral	Natural Fiber Composites with Nanofiller Containing Binders	2007-2008

National:

No.	Type	Name	Period
1.	PN2-HR	Polymeric nanocomposites obtained through polymerization in aqueous medium in the presence of superhydrophobic layered silicates - SILFOB	2010-2012
2.	PN2-Ideas	Polymer composites based on nanosilica networks grew through -soft- methods on nanolamellare entities - SILICORE	2009-2011
3.	PN2-Capacities	High Aspect Ratio Carbon-based Nanocomposites – ROHARCANA	2008-2012
4.	PN2-Collaborative	Medical device for articular diseases treatment based on nanomaterials and magnetic field effects - ARTROMAG	2008-2011
5.	PN2-Collaborative	Eco-efficient solutions for plastic waste management using degradative potential of biological systems - ECODEGRAD	2008-2011
6.	PN2-Collaborative	Design and development of innovative biotechnologies to obtain monascus sp. nanosamples with potential applications in therapy - MONALISA	2008-2011
7.	PN2-Capacities	Creating a centre of expertise for the characterization of polymer nanocomposites - POLINANO	2008-2010
8.	PN2-Collaborative	Nanocomposites with electric and magnetic properties for high selective separative processes - NEMSEPSEL	2007-2010
9.	CEEX	New Nanostructured Materials With Controlled Properties And Biomedical Applications - BIONANOMAT	2006-2008
10.	CEEX	Chromogen-polymeric composite systems for photoinduced surface structures and selective ion sensors - CROMOPOL	2006-2008
11.	CEEX	Therapeutic Nanostructured Iridoids Bio-Products Obtained from Romanian Vegetal Species - NANOIRIDOPLANT	2006-2008
12.	CEEX	Radiolabeled micro and nanospheres for cancer therapy - MAR	2006-2008
13.	CEEX	Surface phenomena and organization in disperse systems with anisotropic fluids - SIDISANIZ	2005-2008
14.	CEEX	Integrated scientific network for multifunctional polymeric materials development based on knowledge - MULTIPOL	2005-2008
15.	CEEX	Nano-composites polymers-inorganic layers used like strengthen hybrids at nano-scale - NANOCHRASN	2005-2008

16.	CEEX	Multi-functional advanced materials with silver nano-powders addition - NACOLAG	2005-2008
17.	CEEX	Textile printing digitization technologies and products complex integrated system - DIGINTEX	2005-2008

Major Infrastructure

- Environmental Scanning Electron Microscope (ESEM);
- Thermal & Thermomechanical Analysis System:
 - Thermal Gravimetric Analysis instrument (TGA);
 - Differential Scanning Calorimeter (DSC);
 - Simultaneous DSC-TGA instrument couplet with Mass Spectrometer;
 - Dynamic Mechanical Analysis instrument (DMA).
- Measurement System of Particles Dimensions by Dynamic Light Scattering, Molecular Weight and Z Potential (DLS);
- Fourier Transform Infrared Spectrometer (FTIR);
- UV-VIS Spectrophotometer.

Visibility actions. International projects

- ENPONA (FP6-2004-ACC-SSA-2-017494)
- HARCANA (FP7-NMP3-LA-2008-213277)

Within this projects have been organized brokerage activities to initiate collaborations with big research centers from Europe. A high number of researchers were interested regarding these meetings (France, Slovakia, England, Germany, Holland).

International partners:

GKSS - Forschungszentrum Geesthacht GmbH, Germany
 Ecole Supérieure de Physique et de Chimie Industrielles de la Ville de Paris, France
 Materia Nova, Belgium
 Université de Liège, Belgium
 GMT Membrantechnik GmbH, Germany
 BORSIG Membrane Technology GmbH, Germany
 Université Catholique de Louvain, Belgium
 Consejo Superior de Investigaciones Científicas, Spain
 Emerson & Cuming Microwave Products NV, Belgium
 FutureCarbon GmbH, Germany
 INERGY Automotive Systems Research SA, Belgium
 Technische Fachhochschule Wildau, Germany
 Ecole Supérieure de Chimie Physique Electronique de Lyon, France
 Polymer Institute - Slovak Academy of Science, Slovakia
 The University of York - Green Chemistry Centre of Excellence, U.K.
 Laboratoire d'Electrochimie et de Physicochimie des Matériaux et des Interfaces, France
 Université de Provence - Laboratoire de Chimie Macromoléculaire, France
 Institut für Verbundwerkstoffe GmbH - Materials Science Department, Germany
 Eindhoven University of Technology - Dpt. of Chemical Engineering and Chemistry, The Netherlands
 Utrecht University - Van't Hoff Laboratory, The Netherlands
 Perugia University, Italy
 Centro Ricerche FIAT, Italy
 Fundación INASMET, Spain
 Sheffield Hallam University, U.K.

Other significant aspects

- Within ENPONA project have been recruited 7 young people to prepare and finalize PhD theses. It were provided the conditions through which each young researcher performed training stage in European centers (France-3, Holland-3, Slovakia-2, England-1, Germany-1)
- Organization of: short visits of **5** abroad experts in ICECHIM; **6** international brokerage events; short visits of **8** Romanian specialists in EU labs.; **4** equipments training courses;

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).

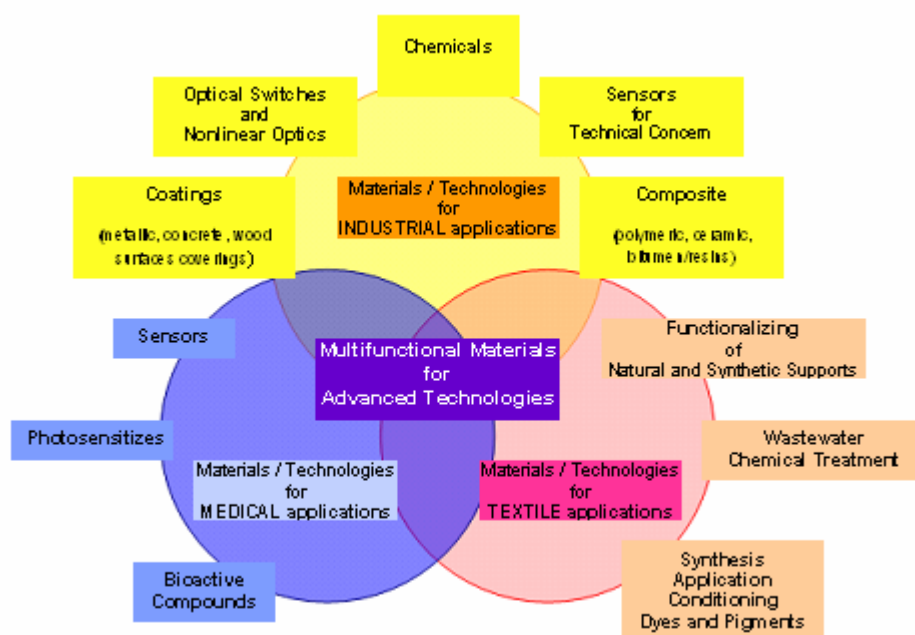


Fig. 1: Research directions

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

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.

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, “*Mesomorfous 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

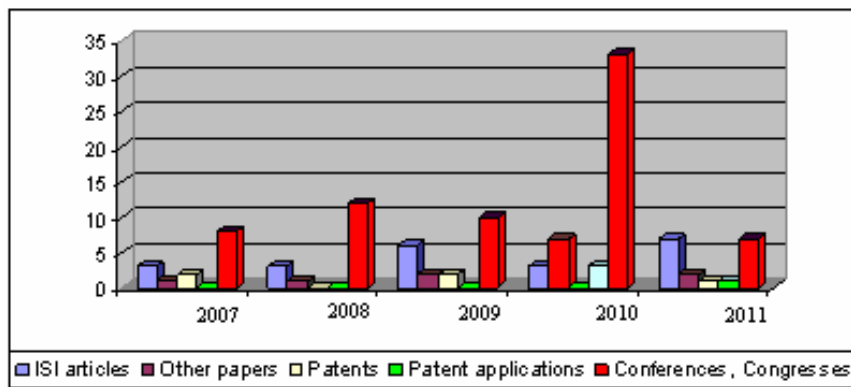


Fig. 2: Dynamic of scientific results

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.

E 11: NANOMEDICINE

Leader Group: Prof.Dr.Rodica-Mariana Ion

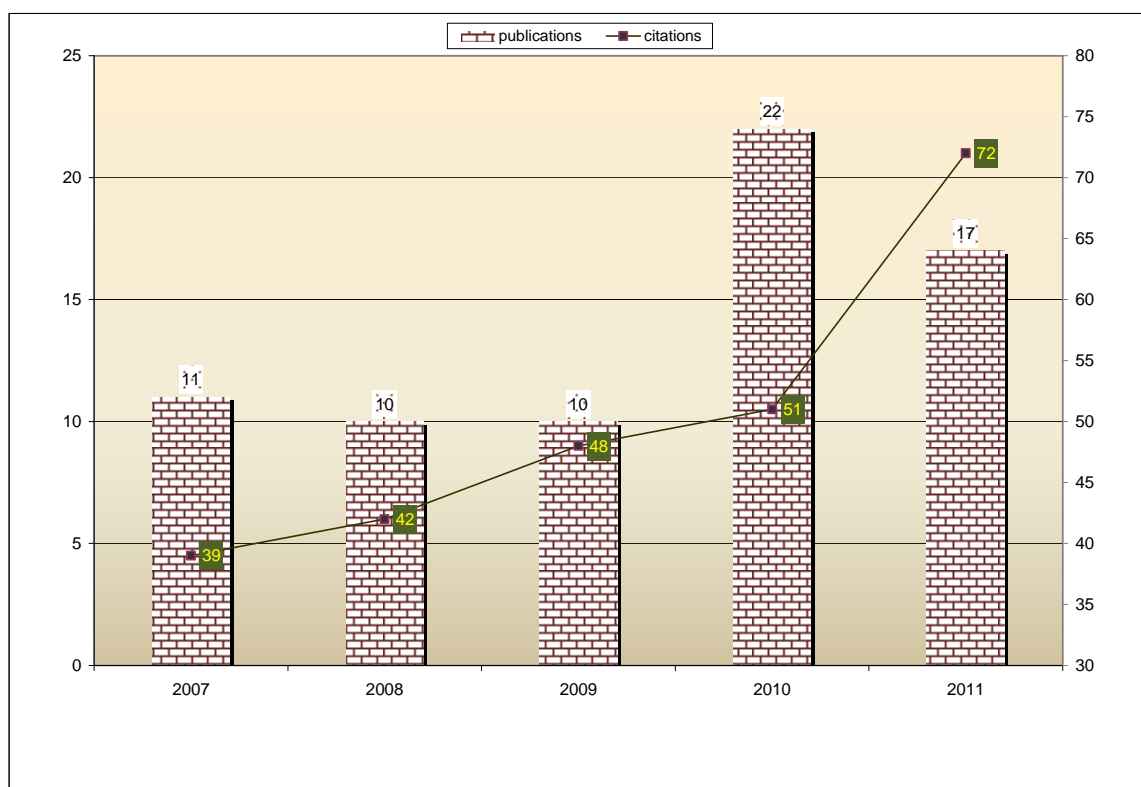
Short description of the research domain

The research area of the Nanomedicine Group, lead by Professor Rodica-Mariana Ion is focused on:

- ☑ the development of novel tools that combine nanomaterials, optics and photochemistry to tackle diagnostic and measurement problems in biomedicine (detection, diagnosis and treatment of human disease, and photodynamic therapy (PDT, a treatment involving sensitizing tissue with photosensitizing drugs which are then activated by laser light);
- ☑ the exploration of the potential and mechanisms of PDT, minimally invasive approach in diagnosis and treatment of Skin Cancer, preclinical study and the photobleaching of photosensitizers;
- ☑ The entire research activity of the team is documented by more than 200 publications in international reviews, has been devoted to the development of laser systems for applications in biology and medicine.

The **Nanomedicine** Group:

- ☑ Promotes the science, technology, and innovation of delivery of bioactives using nanoscale constructs.
- ☑ Research in our laboratory focuses on the design, synthesis and characterization of biomedical compounds: porphyrins, phthalocyanines, nanostructures as fullerenes, carbon nanotubes, so on.
- ☑ Lead independent research projects that are described at this site. They also actively collaborate and support a joint nanomedicine group seminar to foster creative environment, exchange of ideas, and interdisciplinary education of students and postdoctoral scientists.

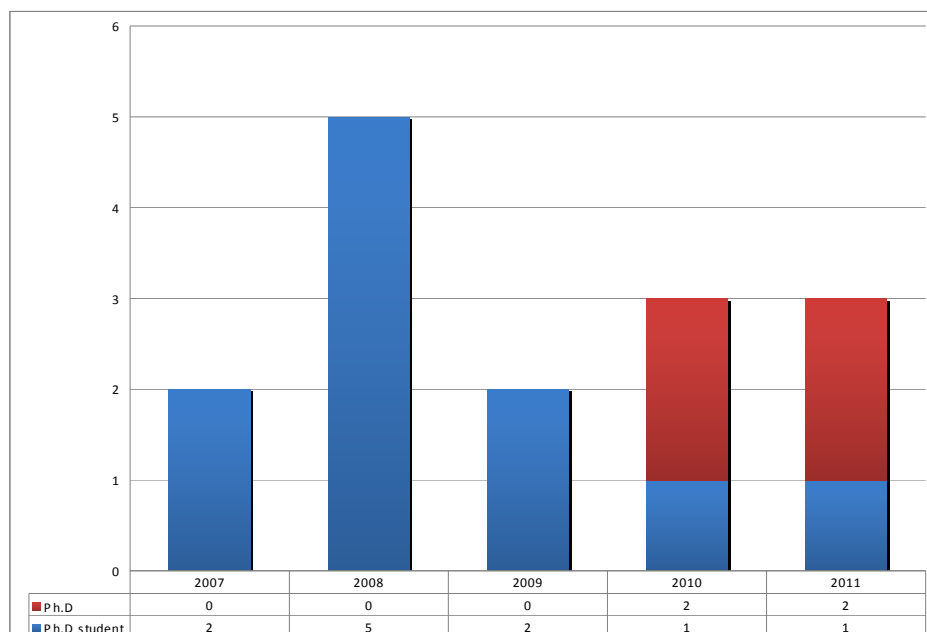


Evolution of publications and citations from 2007 to 2011

Research direction enlargement

- ☑ Nanotechnology has generated a significant impact in nearly every aspect of science. Our research seeks novel nanomaterials and nanotechnologies in order to develop advanced drug delivery systems with the promise to improve health care.

- ☑ Highly interdisciplinary and translational, our research is focused on multifunctional, nanoparticle-based drug delivery systems.
- ☑ We seek to improve nanoparticle synthesis and formulation and its therapeutic efficacy.
- ☑ Develop a fundamental understanding of the interface between nanomaterials and the biological system, all in order to aid in nanoparticle drug development.
- ☑ Develop of a porphyrins nanomaterials school for Ph.D. students



New area of research explored

The instrumentation developed has been also used for diagnostic purposes and restoration /preventive conservation on art works in Cultural Heritage.

New interdisciplinary initiatives

Based on analytical techniques and nanomaterials experience, the group has broadened its scope of competence in the chemical restoration and biological disinfection of paper or textile artifacts.

Visibility actions

International Programs

1. Project FP6 - Development of high throughput approaches to optimize the nutritional value of crops and crop-based foods – DEVELONUTRI
<http://www.scri.ac.uk/research/ppfq/foodquality/foodsafety/develonutri>
2. EuCheMS platform (European Association for Chemistry for Life Science)
<http://www.euchems.org/CFECS/location.cfm>
3. SusChem Platform (European Technology Platform For Sustainable Chemistry)
http://www.suschem.org/en/_related/links-to-national-platforms-or-contact-points
4. COST D39 - "Metallo-Drug design and action"
http://w3.cost.esf.org/index.php?id=189&action_number=D39
5. COST D20/WG0012/02 "New Molecular systems with therapeutic applications in photodynamic therapy of cancer and microbial infections"
http://w3.cost.esf.org/index.php?id=189&action_number=D20
6. COST D18/0003/00 "Lanthanides in diagnosis (in vivo and in vitro)"
http://www.cost.esf.org/domains_actions/cmst/Actions/Lanthanide_Chemistry_Diagnosis_Therapy
7. COST TD1002 "European network on applications of Atomic Force Microscopy to NanoMedicine and Life Sciences (AFM4NanoMed&Bio)"
http://www.cost.esf.org/domains_actions/bmbs/Actions/TD1002

Awards

1. Gold Metal – Romanian Award from the Research Ministry for the Project CEEEX 18/2005, Health area, 2008
2. EUREKA Innova Brussels – Gold metal for a patent request, 2008
3. Prize of Rudy Demotte, Minister President of the Walloon Government – EUREKA Innova Brussels – First prize for the patent request 2008
4. Gold metal with Congratulations of Jury for a patent request, Geneva, 37th Salon of Inventions, 2009;
5. Special prize of Russian Ministry of Science and Education for a patent request, 2009;
6. Excellence Diploma and Silver Medal at PRO INVENT, organized by ExpoTransilvania, Cluj, 2009
7. Award “Best Scientist of the year 2010”, Dinu Patriciu Foundation, Bucharest, Romania;
8. Silver medal at iENA 2010, Nurnberg, Germany;
9. Special Prize and Excellency Diploma from Inventors Organization, Taiwan, iENA 2010, Nurnberg;
10. Excellency medal from Romanian Authority of Scientific Research, for participation at iENA 2010, Nurnberg
11. Gold Medal at 39th Salon of inventions, Genève, 2011;
12. Special Award at 39th Salon of inventions, Genève, 2011;
13. Gold medal at International Salon of Inventions, ARCA, Zagreb, Croatia, 2011
14. Gold Medal at IWIS (Polish Inventions Association), Warsaw, 2011;
15. Gold medal at the 60th Inventions Salon “Innova” – Bruxelles 2011;
16. Special Award from Poland received at the 60th Inventions Salon “Innova” – Bruxelles 2011;
17. Award of the Innova Contest Bruxelles, at the 60th Inventions Salon “Innova” – Bruxelles 2011.

Organization of international conferences

1. 2nd European Conference on Life Sciences, Wroclaw, Poland, 04-08 September 2007
2. 4th European Conference on Life Sciences, Budapest, 31 august-03 September 2011
3. Scientific Committee of International Symposium on Understanding Intelligent and Complex Systems, UICS’2009, Targu Mures, 22-23 October 2009; <http://uics.upm.ro>

Memberships to Editorials Boards of International Journals

1. International J.Photoenergy, 2011 “Photomedicine and Photo Nanosystems”, Guest Editors: Rodica-Mariana Ion, Tebello Nyokong, G. Gyulxhandanyan, Danuta Wrobel; Manuscript Due: May 15, 2011; Publication Date: November 15, ISSN: 1110-662X; e-ISSN: 1687-529X; doi:10.1155/IJP2011; <http://www.hindawi.com/journals/ijp/osi.html>
2. BRAIN. Broad Research in Artificial Intelligence and Neuroscience, ISSN 2067-3957, volume 1, October 2010, Special Issue on Advances in Applied Sciences, Eds Barna Iantovics, Marius M·aru»steri, Rodica-M. Ion, Roumen Kountchev;
3. Editorial Team of Journal of Biophysics and Structural Biology, <http://www.academicjournals.org/JBSB/Email.htm>
4. Editor at Journal of Cancer Research and Experimental Oncology; <http://www.academicjournals.org/jcreo/Editors.htm>

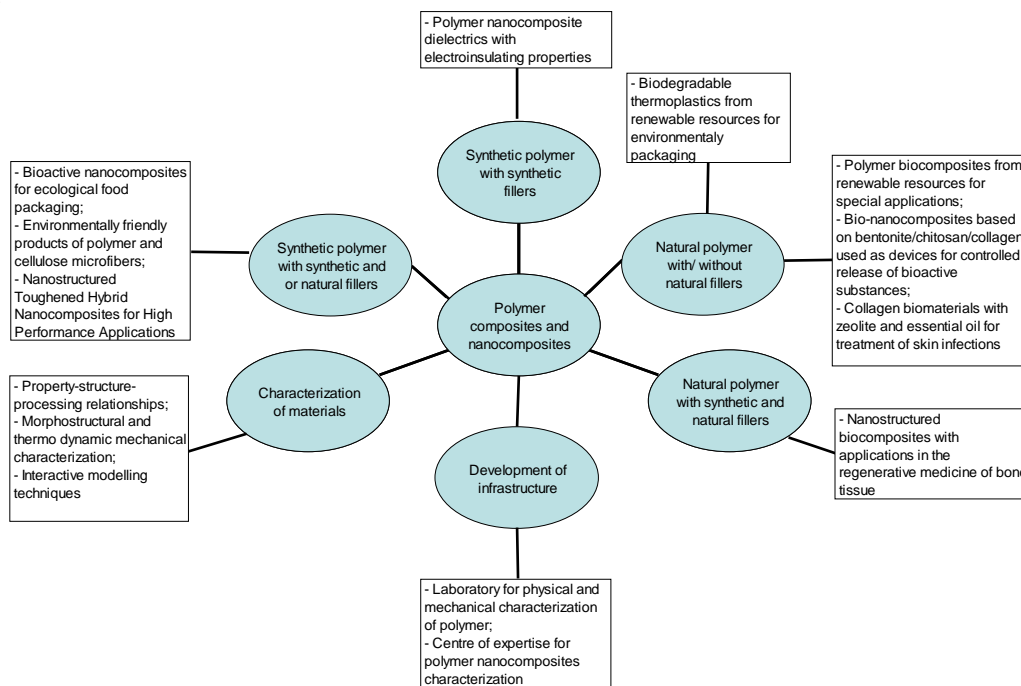
E 12: POLYMER COMPOSITES AND NANOCOMPOSITES

Competence (directions/ research areas)

The research activity of our team is focused on developing new multifunctional materials with imposed properties needed for different applications in packaging industry, automotive, electrical engineering, agricultural and biomedicine. Accordingly, the research directions taken into account have been focused on the characterization, modification, processing and modeling, concerning both the components and (nano) resulted composites, as well as the obtaining processes and interaction mechanisms. The main goals of our research are the enhancement of specific properties required by different applications, improvement of processability, and the replacing of toxic additives and synthetic polymers with natural and renewable ones. In the last few years, the research work was focused on some main directions, including

- a. Obtainment of natural or/and synthetic polymer based composites and nanocomposites with different natural or/and synthetic fillers and nanofillers (cellulose micro- and nanofibres from various renewable resources, starch, chitosan, natural layered silicate, natural zeolite, titania aerogel, calcium phosphates, carbon nanotube, nanosilica, nano-TiO₂ and nano-Al₂O₃) for industrial, agricultural and biomedicine applications, with special consideration of:
 - Synthesis of new environmentally friendly materials, especially in the field of isolation of cellulose micro- and nanofibers from various renewable resources;
 - Surface modification of micro and nanofillers for compatibilisation with polymer matrix.
- b. Characterization of resulting materials with emphasis on the interaction between the major component (matrix) with the dispersed phase and of property-structure-processing relationships.
- c. Development of infrastructure for obtaining and morphostructural and mechanical characterization of new materials (dynamical melt mixing, contact angle, superficial and interfacial tension, atomic force microscopy, thermal and thermo dynamic mechanical characterization);
- d. Recycling of plastic wastes from automobile and electrical and electronic equipment (WEEE).

The objectives of our team are permanently in agreement with thematic area of PC 7 and of national programs.



Team presentation

Human resources: 7 senior researchers (3 CSI, 1 CSII and 3 CSIII), including 3 PhD, 2 scientific researchers, PhD students and 3 technicians. One of PhD students (Catalina-Gabriela Potarniche) has graduated the doctoral thesis in Denmark at Aalborg University and now she is making there a postdoctoral stage. Two years ago, she was detached at Aalborg University, Department for mechanical and manufacturing engineering to work in a FP7 project (NANOTOUGH 213436) in

which ICECHIM was partner. The manager of project from ICECHIM and the leader of one work packages was the manager of polymer composites and nanocomposites team. The other one PhD student (Adriana Nicoleta Frone) has done a thesis in the frame of doctoral program POSDRU/6/1.5/S/19. She made a stage of three month at Laboratoire Materiaux Polymeres - Interfaces - Environment Marin (MAPIEM) at Institut des Sciences de l'Ingenieur de Toulon et du Var, Toulon, France.

Infrastructure: The team has fully equipped laboratories for obtaining and characterization of polymer composites and nanocomposites.

Between 2007 and 2010 our research group has developed its infrastructure in the frame of two national projects, program Capacities: CP 18/2007 and CP 178/2008. In the frame of the first project (18CP/2007-2008 – 450000 euro) two laboratories were developed, one of them for preparation of polymer (nano)composites and rheological characterization of polymers, polymer composites and polymer wastes for recycling and, the second, for mechanical characterization of polymers and polymer composites.

→ Brabender: Plastograph (capacity: 30 and 50 cm³); co-rotating double screw extruder (screw diameter D=20 mm; length = 40 mm); film blowing set with takeover and wrapping film system;

→ Universal system Instron for mechanical testing equipped with video extensometer

The main objective of the second project (178CP/2008-2010 – 197500 euro) was the development of a “Centre of expertise for polymer nanocomposites characterization”, by the development of the existing infrastructure. The new “Centre of expertise for characterization of polymer nanocomposites” was developed by equipping 3 existing laboratories with last generation equipments:

- an AFM microscope for the investigation of samples surfaces, with atomic resolution and measuring of local properties such as adhesion, elasticity or hardness and topographic measurements, supplying information which, at the moment, is not available through other methods, regarding the nanodispersion of the fillers, the material defects, the phase distribution in multiphase mixtures, local rigidity and hardness, etc;
 - a system for measuring interface properties which enables to evaluate the interfacial adhesion in the case of applying some surface treatments to polymers or organic/inorganic (nano)fillers, measuring the contact angle, surface and interfacial tension or adsorption;
 - A laboratory press having automatic cycle for pressing, fine adjustable temperature and high force of sealing the mould for preparation of thin plates and films from polymers and (nano) composites.
- Manometric gas permeability tester, Lyssy
- Thermal & Thermomechanical Analysis System:
- TA Q5000 IR Instrument (TGA)
 - TA Q2000 Instrument (DSC)
 - SDT Q600 Instrument (Simultaneous DSC-TGA)
 - Q800 Mechanical Analysis Instrument (DMA)

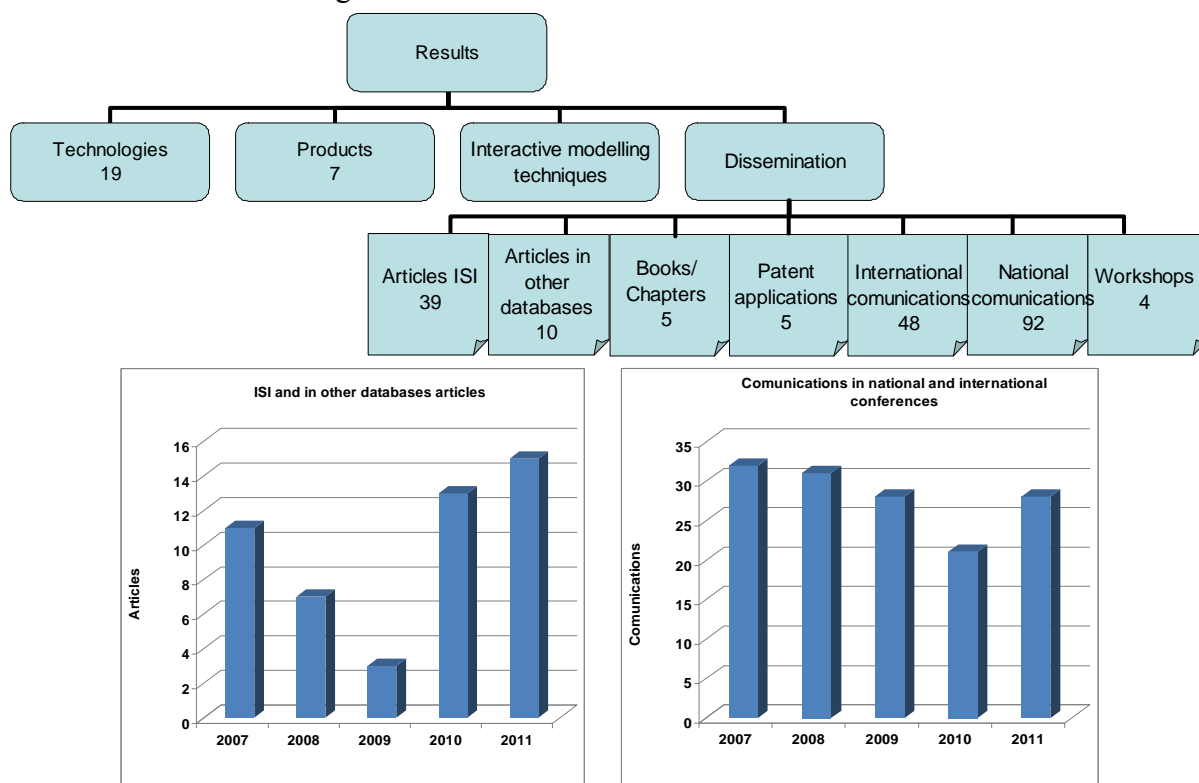
This modern infrastructure provided a natural way for developing new partnerships at national and international levels, including bilateral and FP7 projects.

Scientific performances

Team researchers have been working continually to conclude new projects by exploiting all opportunities and access of various programs: "MATNANTECH-CEEX, RELANSIN-CEEX, PN2-PROGRAM PARTENERIATE, PN2-PROGRAM CAPACITATI and INOVARE". Between 2007 and 2011 the scientist researchers of our team were responsible or managers of 15 national projects, 1 FP7 project and 1 bilateral Project Romania-Turkey.

The results obtained by the team have been materialized in development of technologies, obtaining new products competitive both nationally and internationally. For presentation and demonstration of technologies and products functionality realized at laboratory / micropilot level workshops were organized. National development of strategies of technological areas aimed the achieving of nanostructured biocomposites with applications in regenerative medicine of bone tissue as well as the

bioactive nanocomposites used as environmentally friendly packaging were established. Large scale dissemination was done through publication of articles and papers presentation in national and international scientific meetings.



National/ International recognition

- Catalina-Gabriela Potarniche won 2nd place during Scientific Student Communication in May 2008 – “New nanostructural materials based on natural compounds”
- Several ISI articles were awarded by CNCSIS
- Zina Vuluga received an honorarium of 200 euro for participation in the seminar “Fabrication, Functionalization, and Characterization of Nanofillers Intended for Polypropylene Nanocomposites”, organized at the Technical University of Denmark -DTU, with oral presentation of paper:
 - “The evaluation of the block copolymer-organically modified layered silicate interaction”
- HoriaPaven was invited in Nanotough Seminar, on September 21st 2011, Copenhagen to present the paper: “Characteristic frequencies and temperatures underlying 2D-3D DMTA data in strain- and stress-controlled conditions”

Other significant aspects

- Team researchers are member of the Romanian Association of Polymer Science (ARSP), of the Romanian Association for Materials (ARM), of the Biomaterials Romanian Society, of the Chemistry Society from Romania and of the Central and Eastern European Committee for Thermal Analysis and Calorimetry.
- Adriana Nicoleta Frone has sustained the doctoral thesis on December 12.
- Catalina-Gabriela Potarniche will sustain the doctoral thesis in Denmark, at Aalborg University, on December 15.
- Zina Vuluga, Denis Mihaela Panaitescu and Horia Paven are referents of Journal of Applied Polymer Science, Polymer Engineering and Science and Plastic Materials.
- Horia PAVEN, Cristian-Andi NICOLAE, Raluca GABOR have attended the Short Summer School on TA&C, on September 7, 2011, Craiova, Romania.
- Cristian-Andi NICOLAE has attended the course “EXPERT structural funds and European Cohesion”, April 4-8, Bucharest, 2011.

2.4. REPRESENTATIVE PROJECT

The projects presented below are representatives for the coherent, structured research activity, leading to a fulfillment of the *three main tasks* of INCDP-ICECHIM:

- i. production of results relevant to the scientific community and knowledge development;
- ii. (ii) production of results relevant to society
- iii. (iii) training and formation of new researchers.

In order to fulfill these three main tasks projects related to infrastructure and human resource development were conceived, developed, implemented and concluded.

Project FP6 no. ACC-SSA-2-2004-017494 “*Enhancement the quality participation at FP6 projects in the polymer nanomaterials field – ENPONA*” (2005 – 2008). The upgrading and renewal of existing research facilities was carried out by purchasing some highest performance instruments, complementary to the existing facilities for hybrid polymeric nanomaterials. Major equipments: Environmental Scanning Electron Microscope (ESEM), Measurement System of Particles Dimensions (by Dynamic Light Scattering), Molecular Weight and Z Potential (DLS), UV-VIS Spectrophotometer FT-IR Spectrophotometer.

PNCIDI II – P2 CAPACITIES project PM/CP 1/2008 “*Development of the Bioresources Department by R&D infrastructure modernizing – BIORES*” (2008 – 2011). It was developed and modernized the existing infrastructure of the Bioresources Laboratory in order to establish a modern department with four laboratories: extraction, biofuels, bioproducts, tests and measurements. Major equipments: Photobioreactor (180 L volume), Continuous Flow Tubular Reactor, Fermenter, Supercritical Fluid Extraction System, GS-MS/MS Triple Quad, LC-MS/TOF.

Finalization of these projects enhanced the scientific and technological potential of INCDP-ICECHIM. Project ENPONA, which was also related to human resource development, **resulted** also on: 72 ISI papers; 172 Communications; 5 Books and international book chapters; 1 Patent; 7 PhD; 10 Training stages in European labs.; 4 Postdoctoral fellows; 8 Young graduates hired.

The ENPONA project contribution to human resource development / training and formation of new researchers, of socio-economic importance, was doubled by a significant contribution to knowledge and scientific community development, increasing the visibility of team members and INCDP-ICECHIM.

Infrastructure created by project PM/CP 1/2008 BIORES allows the conception, development, execution and conclusion of projects related to sustainable use of renewable natural resources for the production of “*green chemicals*”, as is exemplified in fig. 1.

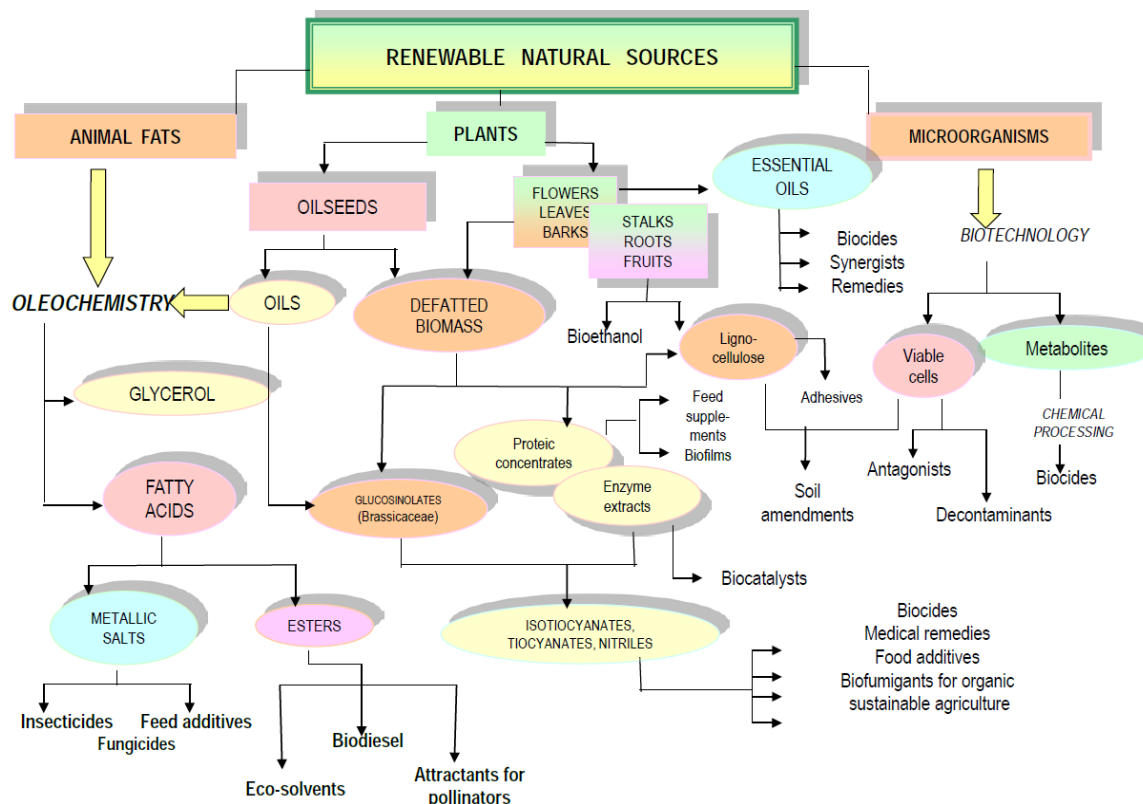


Fig.1. “Green chemicals” resulted from R&D projects related to the infrastructure developed through the Capacity project PM/CP 1/2008 BIORES.

One example of such project is PN2 P4 22-085 “Mitigation of greenhouse gas emissions by means of useful output microalgal systems”. This project is representative for production of results which are relevant for society (green field development of algal practical photosynthesis is one of the solutions for “green chemistry” / biorefinery activity which is not competing with food and feed use of agricultural production). The **results** of this project are:

1. Laboratory technology for cultivation, harvesting and extraction of useful components from algae *Scenedesmus opoliensis 141*, in Biostator PBR - 2S Sartorius photobioreactor, with the following elements of novelty and originality:

- use of BBM (Bold Basal Medium) nutrient, modified by supplementation with NaHCO_3 and NaNO_3 , innovation that has helped achieve a high amount of algal biomass of 5 g / l, compared to 2 g / l as is claimed in other similar studies,
- algal biomass harvesting by electroflocculation, method which allows a rapidly and economically viable harvesting / separation of microalgae from the aqueous medium, with a low energy,
- high efficiency of ultrasonic extraction of lipids from wet algae biomass with a mixture of chloroform : methanol (1:2) avoiding the drying stage, high energy consuming,

Technology performances: exponential growth rate: $0,342 \text{ days}^{-1}$, doubling time 2,027 days, 43...45% lipids in biomass, growth rate of 0,6...0,7 g biomass / liter medium / day, corresponding accumulation of lipids of 250 ... 315 mg / liter medium / day, with a fixation rate of carbon dioxide of

1 ...1,1 mmol CO₂/ liter medium / hour, they are novelty and originality of the application features patent no. A01373/09.12.2011.

2. Laboratory technology for *Haematococcus pluvialis* growth with the new elements: additional growth with vitamin B12 BBM, modification of lighting conditions (increased irradiance to 630 mmol · m² · s⁻¹, under continuous light) associated with increasing environmental salinity growth (4 g / l NaCl) leads to improved growth performance of astaxanthin in *Haematococcus* biomass of 10 times (4-5,7 mg/l).

3. Mathematical modelling of growth and cultivation of algae in the laboratory stage to determine the amount of biomass results and the amount of oil extracted from the algal biomass. By implementing the model for algal growing, according to SuperPro Designer software, simulation was made in accordance with the technological process proposed. After implementing the material balance it follows that for a full cycle of 1 month for growth *Scenedesmus* algae, are obtained 48 g dry biomass by introducing 300 g inoculum, through processing (solvent extraction and separation by distillation), we obtain 18 g algal oil.

4. Development of a lab-scale technology for growing algae *Scenedesmus*, algal biomass harvesting, extraction of lipids fraction and characterization of fatty acid spectrum of algal oil was achieved in pilot-plant experiments. The proportion of over 87% fatty acids C16, C18 and C18: 1 from lipids extracted from algal biomass is convenient conversion into biodiesel (by transesterification), renewable diesel (by hydrolysis of fats, fatty acids separation and decarboxylation and hydrogenation mixture of hydrocarbons derived) and aviation fuels - by hydroprocessing fatty acids to produce synthetic paraffinic kerosene.

The above presented results were included in 2 patents application and 3 scientific articles. The 2 patents application are related to *the first Romanian patent application to algal strains with high efficiency in CO₂ mitigation by practical photosynthesis*. Project PN2 P4 22-085 is representative for INCDPCP – ICECHIM capacity to produce results relevant to society.

Project results exploitation and further developments will be achieved through a technological demonstration project co-funded by **Life⁺ Programme**, LIFE 10ENV/RO/000734 “*Carbon dioxide mitigation from greenhouse gases in algal photosynthetic systems*”. Budget of the project is: total amount - 1,099,548 EUR; EU Co-funding: 45.05%; Duration - Start: 22/09/2011; End - 31/08/2014.

Expected results are: Scale-up of clean and non polluting technology which could be duplicated / adopted to similar CO₂ emission plant; CO₂ mitigation from flue (greenhouse gases) and production of algal biomass used as raw material for biorefinery / green chemistry, providing an option for economically competitive and environmentally safe carbon management; contribution to people's health and quality of life by decreasing the atmospheric pollution and reduced carbon footprint of CO₂ generating plant. The technological process which will be scale-up by the Life+ project generate the following results: bioconversion of CO₂ to biomass - for every 2 kg of CO₂ consumed, 1 kg of

biomass is produced and improving of oxygen content in the atmosphere - for every 1kg of CO₂ consumed, 0.73 kg of O₂ are released.

The project “*New innovative methods of fotochemotherapy with nanostructured photosensitizers—from synthesis to clinical trial*”, supported in conception, development, execution and conclusion by the modernized infrastructure of INCDCP – ICECHIM, deals with the implementation procedure of therapy in the pathology of human dermatological area, through the establishment of a network of research institutions, universities in different regions of the country and from hospital units, owning scientific and practical experience necessary. The project results were:

1. Synthesis of a range of compounds with photosensitive properties, from the **porphyrins and phthalocyanines** classes, with properties fulfilling the criteria of purity and efficiency necessary in bio-medical application;
2. Encapsulation of these compounds into **hydro gels supramolecular structures** with applications into dermatology;
3. **Advanced Toxicology Studies in vitro mammalian cell lines** used industry standard (P388 and L1210 cellular line), fibroblast lines (line 1184), keratinocyte (line DOK), human Melanoma (FM3), normal human endothelial cells (HUVEC-C)
4. **Advanced Toxicology Studies in vivo animal models of carcinogenicity** in the skin and on animal models with murine tumors transplantable (B16 melanoma, carcinoma Lewis) in stages of tumor initiation, promotion and progression
5. **Phase 1 clinical trials on patients** diagnosed in the two hospital units with dermatologist's profile involved in the project and for which consent has been obtained and informed written consent of the Ethics Committees of the respective units and Medical College (the monitoring of their immune parameters (NK cytotoxicity) throughout the project have been carried out in parallel fundamental research studies that focused on investigating the processes of inducing apoptotic effects. Molecular therapy goals, of the photodynamic experimental and dermal stem cells loaded with compounds test, in order to advance efficiency of TFD. Thus, the project has initiated for the first time in country a network of clinical and research units, which have the purpose of implementation of photodynamic therapy in human pathology dermatological.

The *degree of novelty* of the proposed project has resulted in:

- development of the flow synthesis - clinic testing for a new medicinal product with the application of photodynamic dermatological pathology;
- new sensitizer compounds and their application *in vitro* and *in vivo*.
- procedures for sensitizer loading in the stem cells in an animal model with the aim of increasing the degree of efficiency of TFD experimental complexity of the project: to bring together several residing in multi-disciplinary collective of scientists (chemists, physicists, biochemists, doctors, immunologist) who will perform for the first time on national-level clinical justification of an anti-

tumor therapies using local products. Results of the project on a therapy continually advanced stage internationally testing clinical and Para-clinical will be disseminated at meetings and published in journals, giving clinics around the country information and a guide on a therapy at international standards.

Due to the attraction in the team project that proposes young doctoral students involved in the study, the results expected have materialized in the specialization of these young people in an industry leading and achieving a four doctoral in the three universities in the country.

The methodology presented in the project includes techniques of molecular and cellular biology, Chemistry Physics at international standards creating scientific and methodological approach for introduction in our country of a specialized therapeutic pathology dermatological area.

The project **results**: 1 patent application: “*Application of tetrasulphonated porphyrin and its use in the manufacturing of a new photosensitising agent for dermatological therapy*”, 23 ISI publications; 4 Ph.D. thesis, 79 conference papers, 1 COST Action COST D39.