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 then 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 begun to work in the field of polymer recycling (PET bottles and others), other members begun 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 mezoporous 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 founds 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.

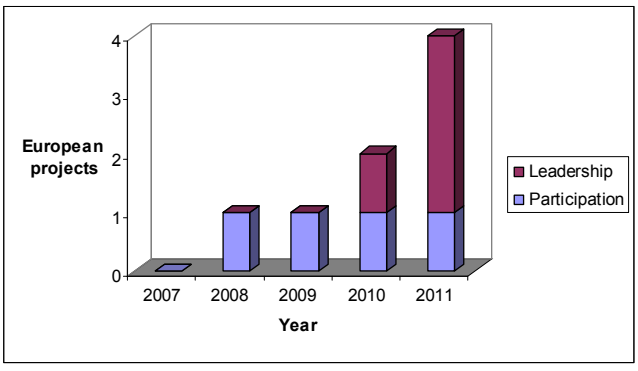


Figure 1: Evolution of international projects

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.

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).

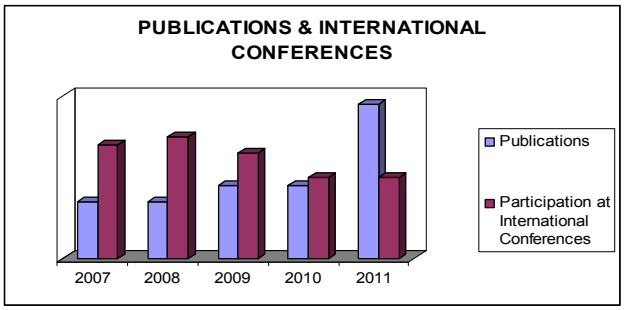


Figure 2 Evolution of publications and participation at international conferences

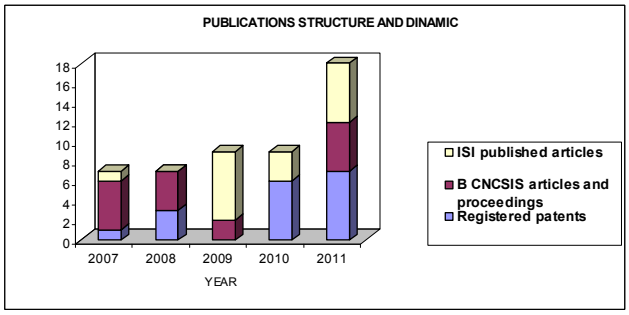


Figure 3 Framing evolution of publications

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. "A_2BA_2 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)

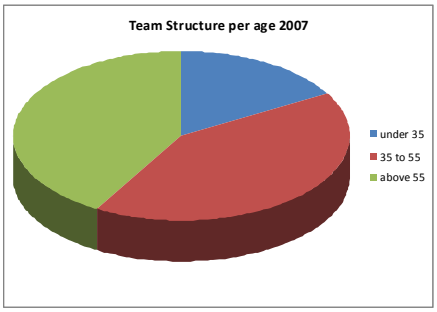
***Homologated Products*:**

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.



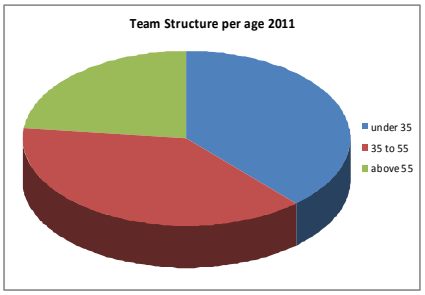


Figure 4: Evolution of team structure per age from 2007 to 2011.

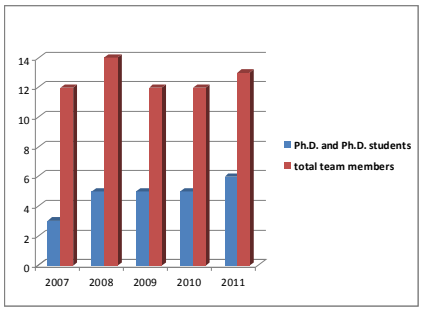


Figure 5: Evolution of team scientific qualification between 2007 and 2011

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 Margaillan, 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).