

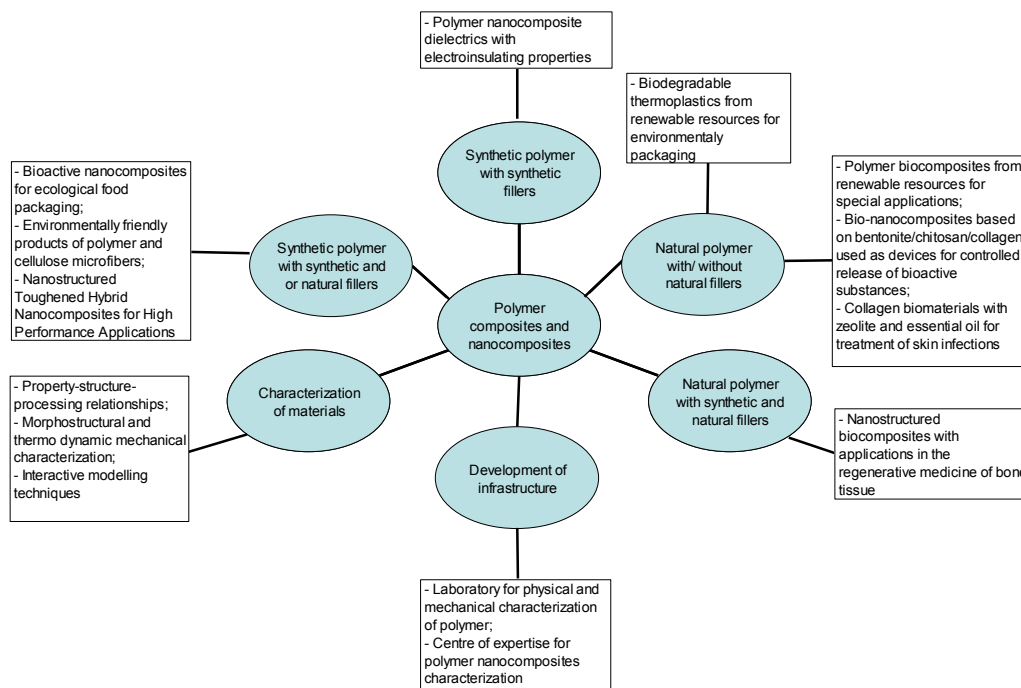
E 12: POLYMER COMPOSITES AND NANOCOMPOSITES

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

- 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.
- Characterization of resulting materials with emphasis on the interaction between the major component (matrix) with the dispersed phase and of property-structure-processing relationships.
- 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);
- 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)

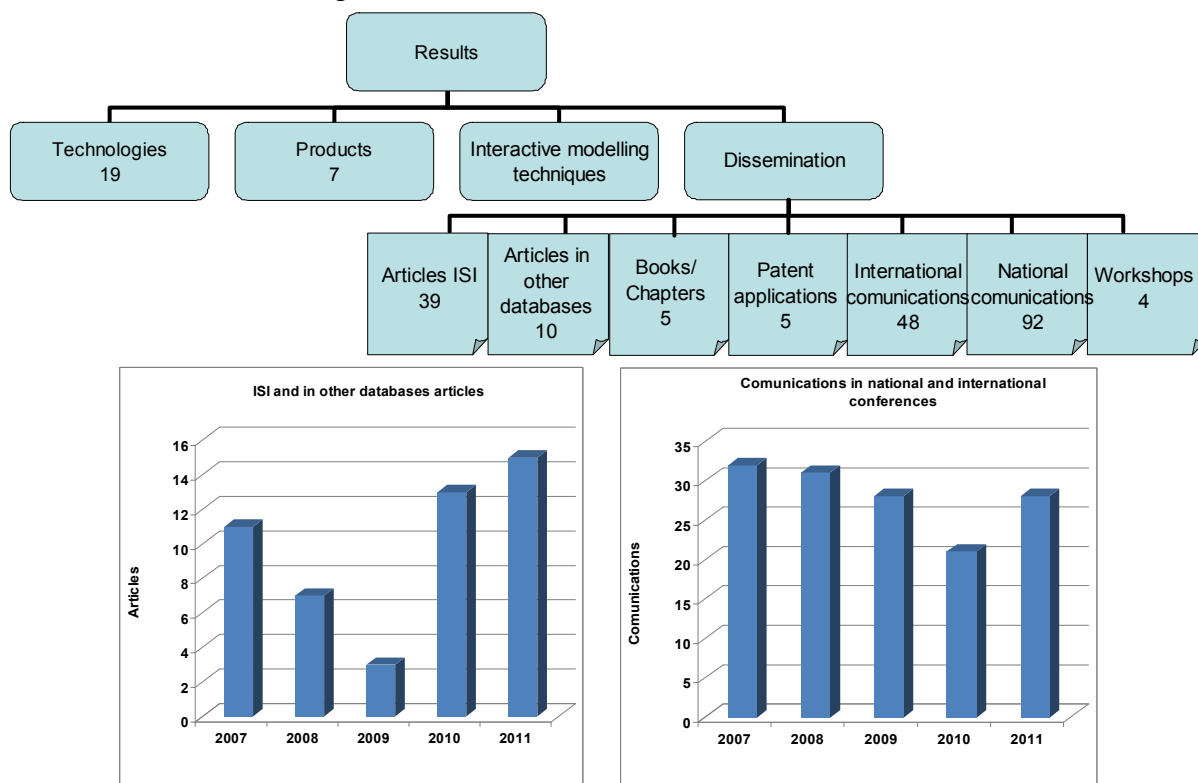
This modern infrastructure provided a natural way for developing new partnerships at national and international levels, including bilateral and FP7 projects.

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”
- Horia Paven 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.