Polymer Group
/ Institute of Materials Chemistry / Faculty of Chemistry
/ Brno University of Technology

THEMATIC RESEARCH FOCUS

RESEARCH AREA
The relationship between structure and properties of polymers, biopolymers, composites and nanocomposites and their fracture mechanics and technology of production.

EXCELLENCE
Our group has achieved world recognized results in the synthesis of amphiphile block copolymers for a wide range of biomedical applications and drug delivery, in understanding the mechanisms and kinetics of thermodynamic transitions in polymer nanocomposites and in their viscoelasticity and deformation behaviour. In addition, excellent results have been obtained in reactive compounding, polymer stability and in computer simulations of complex heterogeneous polymers and polymer composites including bio-nano-composites.

MISSION
» An excellent institute, which is one of the wider world leaders in basic and applied research

DEVELOPED TECHNOLOGIES

CONTENT OF RESEARCH
» Basic research in the physics of polymer nanocomposites
» Development of new polymer or composite materials for applications in electrical engineering, mechanical engineering, civil engineering and medicine
» Assessing the interaction of biological and synthetic materials with elements of the environment in terms of material life and its impact on the environment

MAIN CAPABILITIES

Basic Research:
» Fibre composite materials
» Optical microscopy
» Confocal microscopy
» Deposition and characterization of plasma polymers
» Simulation and Modelling
» Geopolymers
» MDF Composites
» Non-traditional binders and composites
» Corrosion and Protection of metallic materials
» Synthesis of organometallic compounds

Application research + protection forms
» Polymer nanocomposites
» Biomaterials for tissue engineering
» Sol-gel process

FIELDS OF RESEARCH RESULTS APPLICATION

» Advanced mechanical engineering, aerospace and automotive industries
» Biomedical technology
» Microelectronics
» Coatings, sensors
ALUMNI PROFILE

Our graduates are fluent in using a wide range of experimental devices in FTIR and UV VIS spectroscopies, SEM, OM and CLSM microscopies, thermoanalysis (DSC, TGA, DMA), mechanical testing (tensile testers, impact pendulums, rheoviscosimeters) and master a range of specific synthetic techniques (ROMP, ATRP). In addition, theoretical knowledge of the natural laws governing thermodynamic transitions in polymer based systems as well as morphology formation in polymer composites is also part of the skills acquired by our graduates in the course of their Ph.D. studies.

NUMBER OF RESEARCH POSITIONS

SENIOR RESEARCH STAFF

25

JUNIOR RESEARCH POSITIONS (INCL. PH.D. STUDENTS)

47

KEY RESEARCH EQUIPMENT

LIST OF DEVICES

- TGA 6 thermogravimetric analyzer PERKIN ELMER
- TGA Q500 thermogravimetric analyzer TA
- DSC Pyris I Differential Scanning Calorimetry PERKIN ELMER
- DMTA 2980 Dynamic mechanical thermal analyser, TA
- RSA-III dynamic mechanical analyser, TA
- AR-G2 rheoviscosimeter, TA
- DSC 2920 Differential Scanning Calorimetry TA INSTRUMENTS
- ZWICK Z 010 Universal test equipment ZWICK – Roell
- Resil Junior, instrumented impact pendulum, CEAST
- Fractovis, biaxial instrumented impactor, CEAST
- LEXT 3000, Confocal laser scanning microscope, Olympus
- iSpeed-3, ultrafast digital camera, Olympus
- hot-stage, Linkam
- Isoperibolic 16 - digit calorimeter
- TGA + DTA SETERAM
- GPC - Gel permeation chromatography + RI detector
- Image analysis, optical microscope (Olympus BX 50 with an additional light source (Olympus TH 400-200) with a digital camera (Olympus Camedia C - 4040Zoom)
- Scanning probe microscopy Ntegra Prima (NT-MDT)
- High-sheet mixer TWINROLL
- Gravimetric spectrometer Hiden ANALYTICAL
- Chemet - 3000 (Fa Quantachrome)
- Zetasizer 3000HSA (Fa MALLERN)
- Elipsmetr Jobin – Yvon UVISEL
- Chamber electric furnaces CLASIC
- Diffractometer Siemens D500

BUDGET

TOTAL (MIL. CZK/ MIL. EUR)

30 / 1.2

PART OF THE TOTAL BUDGET FROM PRIVATE RESOURCES (%)

10

PART OF THE TOTAL BUDGET FROM FOREIGN RESOURCES (%)

5

MAIN PROJECTS

2005–2011: Multifunctional heterogeneous materials based on synthetic polymers and biopolymers (project MSM0021630501 financed by the Ministry of Education, Youth and Sports)

2010–2012: Effect of nanoparticles on the chain mobility and crystallization kinetics in polyolefin nanocomposites (project GAP205/10/2259 financed by the Czech Science Foundation)


ACHIEVEMENTS

- Jancar J., Recman L., Particle size dependence of the elastic modulus of particulate filled PMMA near its Tg, Polymer, Volume 51, Issue 17, 4 August 2010, Pages 3826-3828
- Kalfus, J.; Jancar, J., Effect of Particle Size on the Thermal Stability and Flammability of Mg(OH)2/EVA Nanocomposites, Composite Interfaces, Volume 17, Numbers 5-7, 2010 , pp. 689-703(15)
MAIN COLLABORATING PARTNERS

COLLABORATION WITH ACADEMIC PARTNERS
- Polymer Science and Engineering Center, University of Massachusetts (US)
- Institute of Materials Science, University of Connecticut (US)
- University of Veterinary and Pharmaceutical Sciences Brno (Brno, CZ)
- Institute of Experimental Medicine, Academy of Sciences of the Czech Republic (Prague, CZ)
- Faculty of Medicine, Masaryk University (Brno, CZ)

COLLABORATION WITH COMPANIES
- Škoda (Mladá Boleslav, CZ)
- VW (Wolfsburg, DE)
- PPG Industries (Pittsburgh, US)
- Ivoclar (Schaan, LT)
- ADM (Brno, CZ)
- Gumotex (Břeclav, CZ)
- Fatra (Napajedla, CZ)
- VÚP (Brno, CZ)

EXPECTATIONS

REQUIREMENTS
- Cooperation with research institutions as well as companies in the field

OFFERS
- Tailor made polymer based materials
- Troubleshooting

Photos:
- Photo 1: Polymer group leader, Professor Jancar, with Nobel Price laureate in chemistry, Professor Alan Heeger, during his visit in the Polymer Group synthetic laboratory
- Photo 2: Versatile, 25mm twin-screw extruder with L/D=36 and many adds on in the Polymer Group polymer processing and modification laboratory
- Photo 3: Morphology of reactor ICPP copolymer deformed in the view area of the Polymer Group Confocal Laser Scanning Microscope