Research Infrastructure Map for ECNP

- **CHEMICAL SYNTHESIS AND COMPOSITES**
- **CHEMICAL COMPOSITION AND STRUCTURE CHARACTERIZATION**
- **PROCESS MONITORING AND PROCESSING FACILITIES**
- **MORPHOLOGY AND SURFACE CHARACTERISATION**
- **MOLECULAR DYNAMICS INVESTIGATIONS**
- **MECHANICAL PROPERTIES**
- **SORPTION, DIFFUSION, PERMEATION**
- **OPTO-ELECTRONIC PROPERTIES**
- **MAGNETIC PROPERTIES**

CHEMICAL SYNTHESIS AND COMPOSITES

Technique	Type of the apparatus	Partner name,Contact person Expertise of the personnel	Types of possible experiments
Organic-chemical synthesis laboratory	**All kind of lab facilities necessary to perform preparative organic chemistry on small and medium scale**	**CSIC** **Dr.Helmut Reinecke** The personnel working in our lab has an excellent training in organic and preparative chemistry	Organic and preparative chemistry
synthesis laboratory	**-Controlled 2.3 l polycondensation autoclave** **-Polymerisation autoclave for controlled metallocene catalysed synthesis of polyolefins (1 l glass to 5 l stainless steel vessels) (0.05 to 1.5 MPa, < 200 °C, argon as inert gas) monitored olefin consumption by pressflow gas controller** **- synthesis labs for small scale batch synthesis (also under inert conditions)** **- high vacuum line for anionic polymerization** **- glove box for synthesis under inert conditions** *In addition:* *-Reaction calorimeter (1.8 l, < 5 MPa, < 220 °C)* *-In-line FT-IR reaction monitoring system*	**IPF** **Dr. Doris Pospiech** **Prof. Brigitte Voit**	**Polycondenation** Synthesis of polyethylene terephthalate (PET) and phosphorous-containing polyethylene terephthalate (P-PET) by transesterification polycondensation in the melt. Reaction monitoring by using the ATR-FTIR in-line technique, Synthesis of polyethers (PEEK, PSU) and phosphorous-containing polyethers (P-PEEK, P-PSU) by polycondensation reaction in solution. **Metallocen-Polymerisation** **Controlled radical polymerization** (ATRP, NMRP, RAFT) **Anionic and Cationic Polymerization** **Synthesis of hyperbranched polymers** by Abx and A2+B3 approaches **Sol-gel reactions** **Polymer analogous reactions**

CHEMICAL SYNTHESIS AND COMPOSITES (2)

Polymer composite laboratory	**E.g. Waltritsch & Wachter filament winding machine, Instron test machines, optical microscopes, Perkin Elmer DSC, Bohlin Instruments rheometer, Gerber fibre fabric cutting machine, Krupp Werner & Pfleiderer twin screw extruder, Fjellman press, Engel injection molding machine, equipment for RTM and vacuum infusion molding, ANSYS FE-software**	**SICOMP** **Lars Liljenfeldt, Marketing Manager** - Composite process development - Prototyping - Design with composites - Composite process simulation - Damage tolerance of composite materials - Materials selection, characterisation and optimisation	Full scale composite processing and prototype development. Design and optimisation of composites. Process optimisation and quality control.
Production of polymeric composite materials	**Semi industrial Autoclave, Aeroform, UK**	**FORTH** **Prof.Costas Galiotis** Production of : -composites incorporating shape memory alloys - polymeric composites - nanocomposites using the RFI technique - different types of polymeric composites with different reinforcing fibers	- Polymer curing and post curing - Production of composites by vacuum bagging of material in prepreg form - Production of nanocomposites with Resin Film Infusion - Monitoring of curing process with different types of sensors.

CHEMICAL COMPOSITION AND STRUCTURE CHARACTERIZATION (1)

Micro-Raman spectroscopy	**Conventional micro-Raman set-up**	**FORTH** **Prof.Costas Galiotis** - polymers and their composites. - reinforcement fibres (Carbon, aramid, PE, PP, etc.) -Stress and strain in composites. -Interfacial characterization of composites - Polymer crystallinity - Analysis of heterogeneous systems	-Stress/ Strain/ Temperature measurements in polymeric composite materials -Polymer crystallinity measurement with reference Raman peaks -Micro-Raman study with back scattering configuration using confocal microscope: -Depth profiling -Mapping
Raman Spectrometer with confocal microscope	**T 64000** **Jobin-Yvon**	**TUL** **Dr. Marcin Kozanecki** -Micro-Raman analysis of heterogeneous systems (organic, inorganic, hybrid) -Low Frequency Raman Scattering -Thin films, polymers and their composites and gels	- Standard Raman experiments with 90° configuration -Micro-Raman study with back scattering configuration using confocal microscope: --depth profiling --mapping
FTIR-ATR	**Spectrum One** **Perkin Elmer/ Pike Technologies**	**CSIC** **Dr.Helmut Reinecke** Surface selectivities in polymeric films	- Structural information on liquids and solid surfaces, - Qualitative depth profiles on solid surfaces

CHEMICAL COMPOSITION AND STRUCTURE CHARACTERIZATION (2)

Attenuated total reflectance spectroscopy	**ATR/FT-IR spectrometer, Spectrum One (Perkin Elmer)**	**INSTM** **Prof. Francesco Paolo La Mantia** FT-IR spectra	-FT-IR spectra (extrusion of film with specimens from 30 μm to 150 μm and sheets with specimens from 100 μm to 200 μm)
liquid NMR spectrometer	**BRUKER AVANCE 300 VARIAN INOVA-300 VARIAN INOVA-400 VARIAN MERCURY-400 VARIAN SYSTEM 500**	**CSIC** **Dr. Maria Luisa Jimeno** -Liquid NMR experiments used in structural determination and conformational analysis	Multidimensional NMR experiments (gCOSY, TOCSY, NOESY, ROESY, gHSQC, gHMBC, selective experiments, DOSY)
Solid state NMR	**NMR spectrometer wide bore 400 MHz Avance™ Bruker, Germany**	**CSIC** **Dr. Leoncio Garrido** Investigation of polymeric and hybrid organic-inorganic materials	-Typical solid state NMR experiments: measurements of NMR relaxation times, morphology - Microimaging
NMR spectroscopy	**Bruker DRX 500** **Bruker Avance 500** **Bruker Avance 300** **Bruker NMR Mouse** **Tecmac Apollo**	**IPF** **Dr. Hartmut Komber** Structure characterization of newly synthesized or modified polymers mainly in solution state but also in swollen state **Dr. Ulrich Scheler** - solid state NMR, e.g., ^{19}F - diffusion and electrophoresis NMR - flow NMR - low-field NMR	- multidimensional experiments - heteronuclear NMR - HR MAS NMR (swollen samples) - solid state NMR experiments - diffusion NMR measurements - flow imaging - relaxation measurements
TGA with mass spectrometer analyzer	**TGAQ500-Thermostar Pfeiffer Vacuum, TA instruments**	**CSIC** **Dr.Alberto Gallardo** **Dr.Carlos Elvira**	Polymers thermal degradation and mass spectrometry of degradation gases, in dynamic or isothermal modes.

CHEMICAL COMPOSITION AND STRUCTURE CHARACTERIZATION (3)

TGA/GC/MS	**Coupled techniques between thermal gravimetric analysis, gas chromatography and mass spectroscopy, Setaram**	**UCLB** **Dr. Bounor-Legaré** - Reactive extrusion -Chemical modification of polymers in molten condition	- Polymer degradation - Quantification of reaction sub products for reactive processing application Organic volatile compounds
TGA	**Q500, TA**	**INSTM** **Dr.Alessandro Calogero** -Use of thermogravimetric analyses in both inert and oxidative atmosphere to gain insight on the degradation mechanisms. -Use of different heating rates to evaluate the weight loss process kinetics.	Tests in Nitrogen or air, in isothermal conditions or heating ramp (or sequence of the two) in the temperature and heating rate reported above Step-Scan mode: temperature automatically kept constant when a minimum weight loss rate is observed.
Combined thermogravimetry-infrared-evolved gas analysis (TGA-FTIR-EGA)	**Pyris 1, (Perkin Elmer)**	**INSTM** **Dr.Alessandro Calogero** Thermal degradation/Thermal oxidation of polymers and nanocomposites polymer based. Thermal /oxidation behaviour of fillers/nanofillers and polymer additives	Thermal degradation / thermal oxidation especially those that involves formation of volatiles products.
TG-DTA	**DTG-60 (Shimadzu)**	**INSTM** **Prof. Antonino Pollicino** - Accelerated weathering of polymer films. - Study of chemical modification induced by photooxidation.	Simultaneous Thermogravimetric (TG) and Differential Thermal Analysis (DTA) for the determination of thermal stability and thermal transition of polymeric system.

CHEMICAL COMPOSITION AND STRUCTURE CHARACTERIZATION (4)

Pyrolysis-GC/MS	**Gas Chromatography module(GC) is a Perkin Elmer Autosystem XL, coupled with a Perkin Elmer Turbomass Gold Mass Spectrometer (MS). Pyrolyser is a SGE Pyrojector Mk2, assembled on the GC injector.(Perkin Elmer and SGE)**	**INSTM** **Dr.Alessandro Calogero** Use of GC/MS for qualitative analyses of solutions (liquid or gas).	Standard GC/MS analyses on liquid or gas samples. GC/MS analyses on volatile products obtained by Flash Pyrolysis (Helium atmosphere) in the pyrolyser when assembled on the GC injector.
Shearing Hot Stage for Microscope	**CSS 450, Linkam**	**UCLB** **Dr. René Fulchiron**	Application: polymer crystallization, polymer blends, droplet deformation
X-ray photoelectron spectrometer (XPS)	**AXIS ULTRA , KRATOS ANALYTICAL**	**IPF** **Dr. rer. nat. Frank Simon** surface spectroscopy in the field of polymer, inorganic oxide materials and hybrid materials characterization,	- The elements oxidation states and detection of functional groups on solid surfaces. - The element distribution measuring of the thickness of coating layers, - Imaging the element and functional group distribution on solid surfaces.
Auger Electron Spectroscopy (AES) / X-Ray Photoelectron Spectroscopy (XPS)	**MICROLAB MKII** **V.G. Scientific**	**INASMET** **José Luis Viviente, *Researcher*** -Biological, biomaterials and biomedical fields. - Nanotechnology, bionanotechnology and nanomaterials.	**INASMET** **José Luis Viviente, *Researcher*** -Biological, biomaterials and biomedical fields. - Forces Microscopy and Tunnel effect: applications in nanotechnology, bionanotechnology and nanomaterials.

PROCESS MONITORING AND PROCESSING FACILITIES (1)

XPS Spectrometer	**VG 500** **(VG Instruments)**	**INSTM** **Prof. Antonino Pollicino** -Surface analysis of polymer systems. Semiquantitative atomic abundance. -Depth profiling by spectral acquisition at different take-off angles. -Curve fitting analysis of envelope. Relative abundance determination of oxidation states.	-Standard XPS experiments -Depth profiling within a sample surface depth of 75 Å. -Spectral curve fitting for function abundance calculation
Microdielectrometry for in situ monitoring	**Dielectric Spectrometer** **Micromet and Netzch**	**UCLB** **Dr.Gérard Seytre** In situ-monitoring of chemical and physical events	- Curing of thermoset and coating, phase separation, cristallisation, monitoring of chemical events
In line UV/Fluorescence for extrusion processing	**PVT-100, Home made**	**UCLB**, **Prof.Cassagnau** - Reactive extrusion - Mixing and dispersion in molten polymers.	In line measurement of the residence time distribution in continuous processing machines. Mixing characterization
Compounding / Extrusion	**Extruders** **Feeding equipment** **Downstream equipment** **Monitoring** **Injection moulding** **Further equipments and tests**	**IPF** **Kretzschmar, Bernd** **Dipl.-Phys. , Head of the Processing Laboratory** - Physical and reactive compounding of thermoplastics, e.g. polymeric nanocomposites, biologically degradable materials, flame-retardant polymers, blends - Extrusion monitoring, e.g. on-line analysis (NIR, ATR, Raman, ultrasonics) and on-line morphology analysis (particle sizes, particle size distributions)	- Compounding/Extrusion - Injection moulding -Tests: Flammability tests; Testing equipment related to processing stages; - Simulation of ageing

PROCESS MONITORING AND PROCESSING FACILITIES (2)

Extrusion	**Twin Screw Extruder mod. MD30-19/A** **Bausano e Figli S.p.A.**	**INSTM** **Prof. J.M. Kenny** Processing of polymeric materials.	-Extrusion of pure thermoplastic polymers. -Melt blending of thermoplastic polymers. -Melt blending of thermoplastic polymers and inorganic additives (i.e. microcomposites, nanocomposites).
TGA/GC/MS	**Coupled techniques between thermal gravimetric analysis, gas chromatography and mass spectroscopy, Setaram**	**UCLB** **Dr. Bounor-Legaré** - Reactive extrusion -Chemical modification of polymers in molten condition	Polymer degradation Quantification of reaction sub products for reactive processing application Organic volatile compounds
Internal Mixer - Torque rheometer	**HAAKE PolyDrive Mixer , Thermo**	**INSTM** **Prof. Francesco Pilati** Melt compounding of polymer with fillers, melt blending or polymers, reactive blending of polyesters and polycarbonates.	testing thermal and shear degradation behavior of polymers and for preparing new polymer-additive formulations, polymer blends and to study Reactive blending.
Polymer composite laboratory	**E.g. Waltritsch & Wachter filament winding machine, Instron test machines, optical microscopes, Perkin Elmer DSC, Bohlin Instruments rheometer, Gerber fibre fabric cutting machine, Krupp Werner & Pfleiderer twin screw extruder, Fjellman press, Engel injection molding machine, equipment for RTM and vacuum infusion molding, ANSYS FE-software etc.**	**SICOMP** **Lars Liljenfeldt** **Marketing Manager** - Composite process development - Prototyping - Design with composites - Composite process simulation - Damage tolerance of composite materials - Materials selection, characterisation and optimisation	Full scale composite processing and prototype development. Design and optimisation of composites. Process optimisation and quality control

PROCESS MONITORING AND PROCESSING FACILITIES (3)

Production of polymeric composite materials	**Semi industrial Autoclave, Aeroform, UK**	**FORTH** **Prof.Costas Galiotis** Production of : -composites incorporating shape memory alloys - polymeric composites - nanocomposites using the RFI technique - different types of polymeric composites with different reinforcing fibers	- Polymer curing and Post curing - Production of composites by vacuum bagging of material in prepared form - Production of nanocomposites with Resin Film Infusion - Monitoring of curing process with different types of sensors
Injection Moulding	**Sandretto Micro 30/107** **Sandretto Industrie SPS**	**INSTM** **Prof. J.M. Kenny**	Sample production;Investigation on the material performance (mechanical properties, weight, density, ecc.) for different processing parameters.
Resin Transfer Moulding	**Hypaject MkII** **Plastech Thermoset Tectonics**	**INSTM** **Prof. J.M. Kenny**	-Sample production - Investigation and Modelling on the permeability and the Capillary pressure of the fibrous reinforcement; - Flow models verification (flow front evolution, flow rate, pressure profiles and pressure loss inside the cavity)

PROCESS MONITORING AND PROCESSING FACILITIES (4)

clean room facilities	**spin-coater, zone-casting layer deposition system and vacuum evaporator (Edwards Auto 306 Turbo), Scanning Force Microscopy (Solver PRO, NT-MDT)**	**TUL** **Dr. Ireneusz Glowacki** The producing of the organic material layers for apllication in opto-electronics.	-Producing of the polymeric layer -Producing of the high oriented layers using the low molecular weight materials with the tendency to crystallization
Rubber Processing Analysis	**Rubber Processing Analyser, RPA**	**CSIC** **Dr. Miguel Angel Lopez Manchado** Processing and characterization of rubber compounds: Preparation of compounds, vulcanization reaction, cure kinetics, mechanical, dynamical and thermal properties	The properties of raw rubber, compounded or product for cure time, strain sweep, frequency sweep, temperature sweep, matrix, stress relaxation, variable temperature analysis and delay.
Cone calorimetry	**Cone calorimeter apparatus (Fire Testing technology)**	**INSTM** **Eng. Filippo Canta** Ability to perform standard tests following ISO 5660 normative	Standard cone calorimeter tests can be carried out with this apparatus. The parameters can be obtained are: Heat Release Rate (curves, average, peak), Total Heat Release, Effective Heat of Combustion, Total Oxygen Consumed, Time to Ignition, Mass Lost, Mass Loss Rate, Specific Extintion Area, Total Smoke Released, CO and CO_2 yield

PROCESS MONITORING AND PROCESSING FACILITIES (5)

UL94	**no apparatus required**	**INSTM** **Eng. Filippo Canta** We are specialized in testing plastic materials.	It allows to determine the material's tendency either to extinguish or to spread the flame once the specimen has been ignited.
Limiting Oxygen Index	**OI Apparatus** **(FIRE)**	**INSTM** **Eng. Filippo Canta** We are specialized in testing plastic materials.	Determination of the minimum oxygen concentration at which the flame is sustained in candle like burning test on polymeric samples.
Biological laboratory	**microbiology, toxicology, flow cytometry, spectrophotometry, spectrofluorometry, Fluorescence Microscopy).**	**INASMET**	Tribological tests: wear and friction. Measurement of topography: roughness meter, non-contact profilometry, AFM, etc. Coating tests (Adherence, conventional hardness, ultramicrohardness, thickness, crystallinity, composition and microstructure, etc.). Microhardness tests (Vickers and Knoop). Measurement of hydrophobicity (surface energy): Angle of contact.
QUV Accelerated weathering Tester	**QUV/spray** **Solar eye - spray, UVB lamps - Tensile Adaptor Panel Holder**	**INSTM** **Prof. J.M. Kenny**	Materials can be subjected to artificial and accelerated weathering tests which simulate natural weathering. Controlled cycles of ultraviolet radiation, water spray, and heating elements are used to simulate the natural conditions of sun, rain and temperature changes.

MORPHOLOGY AND SURFACE CHARACTERISATION (1)

Optical Microscopy	**DM LP (Leica)**	**INSTM** **Prof.Francesco Paolo La Mantia** Acquisition of images and quantitative analysis (particle size distributions, morphological analyses of polymer blends through droplet size and number counts, density distributions	Polarization microscope for all polarization-optic observations, examinations and measurements in parallel (orthoscopic) and convergent (conoscopic) light. Acquisition of images and quantitative analysis
Shearing Hot Stage for Microscope	**CSS 450 Linkam**	**UCLB** **Dr. René Fulchiron** - Flow induced crystallization of polymers - Morphology development after shear in polymer blends	Application: Polymer crystallization, polymer blends, droplet deformation.
Scanning Electron Microscopy	**Environmental scanning electron micrsocope**	**CSIC** **José David Gómez, Technical Engineer** Pattern surface characterization	- Surface characterization - Measurements or surface patterns, images of surface details.
Scanning Force Microscopy	**Scanning Force Microscopy; Nanoscope IIIa-Multimode, -Bioscope, -D3100, Nanoscope IV-D3100 / MFP-3D**	**IPF Dipl.-Phys. Andreas Janke** surface characterization by AFM (since 1992) and SEM	- Surface morphology / roughness - Phase imaging / material contrast, electrical charge distribution, magnetic contrast
Scanning Force Microscopy	**Solver PRO, NT-MDT**	**TUL Dr. Ewa Dobruchowska** surface characterization by AFM	- Surface morphology / roughness - Phase imaging / material contrast, electrical charge distribution, magnetic contrast

MORPHOLOGY AND SURFACE CHARACTERISATION (2)

Scanning Force Microscopy	**NANOSCOPE Multimode Digital Instruments (VEECO)**	**INASMET José Luis Viviente, researcher** - Biomaterials and biomedical fields. - Bionanotechnology and nanomaterials	- Micro and nanometric dimensional measurements. - Electric potential and force measurements
Field Emission Scanning Electron Microscope	**SUPRA25 Zeiss**	**INSTM Prof. J.M. Kenny**	-Electron image of conductive surfaces -Microanalysis (quantitative and quantitative analysis) on conductive samples in solid state
Atomic Force Microscopy	**Nanoscope IV (Veeco Instrument SAS)**	**INSTM Prof.Roberto Solaro** Material with nanomechanical properties, nanoindentation, nanoscratching, ink pen lithography	Imaging of surfaces up to at atomic resolution, imaging of cells, also in culture medium, investigation of material with nanomechanical properties, nanoindentation, nanoscratching, ink pen lithography
Atomic Force Microscopy	**DFM System, NanoSurf**	**INSTM Prof. J.M. Kenny** Carbon nanotubes alone or in nanocomposite, organic and inorganic polymers (metalized), stem cells on polymers, antique ceramics, epoxy resins, proteins	Topography of surfaces
HR TEM	**2010 JOEL**	**INSTM Dr. Orietta Monticelli** -Preparation of nanocomposite samples -Nanocomposite morphology compositional analysis by EDS	Morphological and compositional analyses

MORPHOLOGY AND SURFACE CHARACTERISATION (3)

RheoSAXS (WAXS) Combination of SAXS / WAXS with rheometer or mechanical tensile testing	**3-pinhole collimated x-ray camera equipped with a rotating anode generator ultraX-18**	**IPF** **Prof. Manfred Stamm, Dr. Dieter Jehnichen** Investigations in polymers and polymer nanomaterials	-Structureand structure changes in polymers and polymer nanomaterials - Order-disorder transitions of nanostructured polymers
SAXS-Kratky	**KRATKY compact small-angle system with temperature control [Hecus, Graz, Austria,**	**IPF** **Dr. Dieter Jehnichen**	SAXS (and IMAXS) in transmission technique Morphology of standard polymers - nanocomposites as to the intercalation and exfoliation processes
XR / GID / WAXS (Θ/Θ-diffractometer)	**2-circle X-ray diffractometer XRD 3003 T/T [GE Inspection Technologies, Ahrensburg, Germany**	**IPF** **Dr. Dieter Jehnichen**	- WAXS (and IMAXS) -Crystallinity, crystallite size, coefficients of linear expansion - phase analysis -Simple depth profile - Temperature-dependent experiments for discontinuous heating/cooling cycles

MORPHOLOGY AND SURFACE CHARACTERISATION (4)

4-circle wide-angle diffractometer P4	**WAXS, Karlsruhe, Germany [former: Siemens]**	**IPF** **Dr. Dieter Jehnichen** - Polymer physics, physical chemistry of polymers - Structure-property relationships	WAXS (and IMAXS) in transmission technique - 2D-scattering pattern of bulky material, powder, fibres or otherwise oriented (textured) samples, determination of crystallinity, crystallite size, orientation parameters - Phase analysis (determination of modifications)
X-ray photoelectron spectrometer (XPS)	**AXIS ULTRA , KRATOS ANALYTICAL**	**IPF** **Dr. rer. nat. Frank Simon** - Surface spectroscopy. - Characterization of polymers and norganic oxide materials and hybrid materials	- Depth profiles - The thickness of coating layers, covering thin films - The molecular ordering in self-assembled surface layers. -Spectroscopy of samples having a high vapour pressure
X-ray photoelectron spectrometer (XPS)	**AXIS ULTRA , KRATOS ANALYTICAL**	**IPF** **Dr. rer. nat. Frank Simon** Surface spectroscopy in the field of polymer, inorganic oxide materials and hybrid materials characterization,	- The elements oxidation states and detection of functional groups on solid surfaces. - The element distribution measuring of the thickness of coating layers, - Imaging the element and functional group distribution on solid surfaces.
wide and small angle X-ray diffraction	**diffractometers, Philips (WAXD reflection geometry), Italstructures (WAXD transmission geometry), MBraun (SAXS)**	**INSTM** **Dr. Carla Marega**	- Standard powder X-ray diffractometry experiments - Characterization of the morphology of polymeric lamellar stacks - Study of polymorphism, crystallinity - degree, average crystallite size of polymeric samples - Study of the thermal behaviour

MORPHOLOGY AND SURFACE CHARACTERISATION (5)

Auger Electron Spectroscopy (AES) / X-Ray Photoelectron Spectroscopy (XPS)	**MICROLAB MKII** **V.G. Scientific**	**INASMET** **José Luis Viviente, *Researcher*** -Biological, biomaterials and biomedical fields. - Nanotechnology, bionanotechnology and anomaterials.	Characterization of solid samples surfaces extracted from different materials electrically conductive: metals, ceramics, composites, fibres, materials with different surface treatments, thin films of greasy or other compounds -determination in a superficial level (first atomic layers ~3 nm)
Scratch Tester	**CSM Micro Scratch tester** **(CSM)**	**INSTM** **Prof.Francesco Pilati** Single-pass and multi-pass scratch test with constant and/or increasing load on polymeric, metallic, ceramic substrates.	Characterization of coated substrates: parameters such as stylus penetration depth profile, critical load for coating detachment and coefficient of friction can be measured and information about adhesive strength can be achieved
ellipsometer	**Spectroscopic ellipsometer M-2000VI**	**IPF** **Dr. Klaus-Jochen Eichhorn** Ellipsometry measures in polymers.	- Thickness and optical constants of thin layers on solid substrates - In situ experiments on the solid/liquid interface
FTIR-ATR	**Spectrum One** **Perkin Elmer/ Pike Technologies**	**CSIC** **Dr.Helmut Reinecke** Surface selectivities in polymeric films	- Structural information on liquids and solid surfaces, - Qualitative depth profiles on solid surfaces
Raman Spectrometer with confocal microscope	**T 64000** **Jobin-Yvon**	**TUL** **Dr. Marcin Kozanecki** -Micro-Raman analysis of heterogeneous systems (organic, inorganic, hybrid) -Low Frequency Raman Scattering	-Micro-Raman study with back scattering configuration using confocal microscope: --depth profiling -- mapping -- Polarized Raman spectra

MORPHOLOGY AND SURFACE CHARACTERISATION (6)

Determination of the surface free energy of porous solid systems	**Tensiometer K12 and K14 (single fibre)** **KRÜSS GmbH, Germany**	**IPF Dr. Karina Grundke** - Fibre bundles - Modified powder and particles	Determination of the surface free energy of porous solid systems
MicroGlider	**Fries Research and Technology GmbH, Friedrich-Ebert-Straße 51429 Bergisch Gladbach**	**IPF Dr. Victoria Dutschk** Adhesion and adsorption phenomena, surface forces, wetting and wetting dynamics on polymer surfaces	- Surface roughness and waviness and surface structure analysis - The thickness of polymer layers
Contact angle measuring devices G 40, DSA 10 and OCA 40 micro	**drop profile analysis device** **Kruess GmbH, DataPhysics GmbH**	**IPF Dr. Karina Grundke**	Determination of the wetting behaviour on samples and structures
Devices for simultaneous determination of density and surface (interface) tension of polymer melts at high temperatures	**modified Wilhelmy balance technique, ADSA-P (Axisymmetric Drop Shape Analysis Profile)** **IPF [institute made]**	**IPF Dr. Karina Grundke** - Adhesion study - Processes during matrix /glass fibre interface formation - Wettability of polymer films	Density and surface (interface) tension of polymer melts at high temperatures.
Contact angle measuring systems ADSA-P (Axisymmetric Drop Shape Analysis - Profile) and **ADSA-CD (Contact Diameter)**	**ADSA-software: Prof. Neumann, University of Toronto; Special-setup's : IPF[institute made]**	**IPF Dr. Karina Grundke** -Swelling behaviour of membranes under certain conditions - Adsorption experiments of proteins, surfactants and electrolytes	- Swelling behaviour of membranes under certain conditions - Adsorption experiments of proteins, surfactants and electrolytes

MORPHOLOGY AND SURFACE CHARACTERISATION (7)

Contact Angle	**FTA2000** **First Ten Angstroms**	**INSTM** **Prof. J.M. Kenny**	Measurement of contact angle – surface tension, surface energy, work of adhesion, static, advancing/receding contact angles, pendant drop and oscillating drop surface tension.
ZetaSizer 3, ZetaSizer 3000 and ZetaSizer Nano ZS	**light scattering system** **Malvern Instruments**	**IPF** **Dr. Cornelia Bellmann** colloid chemistry	Electrophoreses by M3-PALS, particle size determination by PCS
Plasmon Resonance Spectroscopy	α-SPR prototype, **Sensia SL**	**CSIC** **Dr.Alberto Gallardo**	Biomaterial characterization, since it is able to monitor in real time and in situ any dynamic process
Electrokinetic analyzer EKA	**Producer: A. Paar**	**IPF** **Dr. Cornelia Bellmann** colloid chemistry, solid surface analysis	Streaming potential measurements vs. pH, time, electrolyte concentration, surfactant or polyelectrolyte concentration
Acoustic and electroacoustic spectrometer DT-1200	**Dispersion Technology, Inc.**	**IPF** **Dr. Cornelia Bellmann** colloid chemistry	- Electroacoustic studies for calculation electrokinetic data - Study of particle size distribution by acoustic attenuation measurements

MOLECULAR DYNAMICS INVESTIGATION (1)

Broadband Dielectric Spectroscopy	**Novocontrol ALPHA-ANB with QUATRO Cryosystem,** **Solartron 1260 with Novocool Cryosystem (NovocontrolR).**	**TUL** **Dr. Lidia Okrasa** Dielectric spectroscopy of organic, polymeric and inorganic systems Relationships architecture morphology properties	- Dielectric properties of polymers and heterogeneous materials - Molecular dynamic of polymer
Broadband Dielectric Spectroscopy	**Dielectric Spectrometer Novocontrol**	**UCLB** **Dr. Isabelle Stevenson** Relationships architecture morphology properties	- Dielectric properties of polymers and heterogeneous materials - Molecular dynamic of polymer
Microdielectro-metry for in situ monitoring	**Dielectric Spectrometer Micromet and Netzch**	**UCLB** **Dr.Gérard Seytre** In situ-monitoring of chemical and physical events	Curing of thermoset and coating, phase separation, crystallisation, monitoring of chemical events
Rheometry	**Controlled stress/controlled rate rheometer TA AR1000-N (TA Instruments)**	**CSIC** **Dr. Daniel López** Flow experiments of gelling solutions and oscillatory experiments of gels	Oscillatory, flow and creep experiments of solids, solutions, melts and gels with plate-plate and cone-plate geometries
Differential Scanning Calorimeter (DSC)	**Q1000** **Producer: TA Instruments**	**INSTM** **Dr. Alessandro Calogero** Determination of temperature of glass transition/melting. Evaluation of percentage of crystallinity, and every measure related to polymer transitions/ reactions.	- Temperature of Glass transition, - Temperature of melting - Evaluation of enthalpy of reaction/melting. - The modulated DSC permits to divide enthalpy from heat of irreversible processes (e.g. water evaporation, protein denaturation).

MOLECULAR DYNAMICS INVESTIGATION (2)

Thermal analysis (differential scanning calorimetry and thermogravimetry) (DSC)	**DSC 2920 and SDT 2960 (TA Instruments)**	**INSTM** **Dr. Carla Marega** - Study of melting/crystallization behaviour under isothermal and non isothermal conditions - Assessment of equilibrium melting temperatures and of the free energy of folding.	- Study of melting/crystallization behaviour under isothermal and non isothermal conditions - Assessment of equilibrium melting temperatures and of the free energy of folding.
Modelling and Simulation	**Workstation with 2 Xeon, 2GB RAM and HD500GB under WXP64**	**CSIC** **Dr. Javier Sacristán** Molecular Dynamics, Atomistic and Coarse Grained Models	Study by means of united atom, atomistic and coarse grain models of: - diblock copolymer solutions in water. - dynamics of Polymer Blends and other multicomponent systems. - strucutre, dynamics and properties of physical and chemical gels.

MECHANICAL PROPERTIES (1)

Mechanical Test Equipment	**Mechanical testers for large scale specimens, Hownsfield, UK, 1987** **Mechanical Test Equipment** **Mechanical testers for small scale specimens (thin films, fibers etc.), Minimat, Polymer Laboratories, USA, 1985**	**FORTH** **Prof.Costas Galiotis** - Mechanical properties of polymers and composite materials - Shape memory alloy wires - Interfacial properties of composite materials and nanocomposites	- Static Mechanical tests - Static mechanical tests with temperature of up to 300 C It can be mounted on a Micro - Raman system.
DMA	**Tritec2000DMA (Triton, 2006)**	**INSTM** **Prof. Antonino Pollicino** - Accelerated weathering of polymer films. - Study of chemical modification induced by photooxidation.	All Dynamic Mechanical Analyses (expecially on thin film samples) DMA systems can perform analysis on many types of samples for example: Bars (All bending geometries), Films (Tension), Fibres (Tension), Powders (Using Materials Pocket in bending geometry), Foams Compression, Semi-solids (Shear or special geometry option).
Impact Test Machines	**Dynatup® 9250HV**	**INSTM** **Prof.Francesco Pilati** (the equipment has been installed in April 2007)	Impact testing: falling dart, Izod, Charpy, etc. (at present only the accessory for falling dart has been achieved). Impact testing can be carried out by controlling either energy, dart speed, (force and energy vs. time can be recorded). The equipment is designed for testing plastics, ceramics, composites, and low energy metal alloys.

MECHANICAL PROPERTIES (2)

Scratch Tester	**CSM Micro Scratch tester (CSM)**	**INSTM** **Prof.Francesco Pilati** Single-pass and multi-pass scratch test with constant and/or increasing load on polymeric, metallic, ceramic substrates.	Characterization of coated substrates: parameters such as stylus penetration depth profile, critical load for coating detachment and coefficient of friction can be measured and information about adhesive strength can be achieved.
Capillary Viscometry	**Ubbelohde Viscometer (Schott)**	**INSTM** **Prof.Francesco Paolo La Mantia** -Determination of absolute and relative kinematic viscosity of liquids with Newtonian flow behaviour. -Intrinsic viscosity measurements of any polymer solution.	- Determination of absolute and relative kinematic viscosity of liquids with Newtonian flow behaviour. - Intrinsic viscosity measurements of any polymer solution.
Rheometer	**ARES N2 DMA** **Rheometric Scientific**	**INSTM** **Prof. J.M. Kenny**	Visco-elastic measurements in the melt and solid state, creep and stress relaxation studies, time-temperature superposition and WLF parameter determination. Rotational cone and plate or parallel plate rheology in steady or dynamic modes
Electromechanical Universal Testing Machine	**4502 Instron**	**INSTM** **Prof. Alessandro Pegoretti** -Ramp tests under displacement control -Stress relaxation experiments -Creep experiments	- Ramp tests under displacement control - Stress relaxation experiments - Creep experiments

MECHANICAL PROPERTIES (3)

Termomechanical analyzer	**TMA7** **Perkin – Elmer**	**INSTM** **Prof. J.M. Kenny**	Compressive modulus - penetration measurements - linear coefficient of thermal expansion and contraction
Instrumented Impact Pendulum	**model 6549 CEAST**	**INSTM** **Prof. Alessandro Pegoretti** All types of conventional and non conventional (eg Fracture mechanics) mechanical tests	-Instrumented Charpy impact tests -Instrumented tensile impact tests
Servohydraulic Universal Testing Machine	**MiniBionix 858, MTS**	**INSTM** **Prof. Alessandro Pegoretti** All types of conventional and non conventional (eg Fracture mechanics) mechanical tests.	-Ramp tests under displacement or load control -Stress relaxation experiments -Creep experiments. -Fatigue experiments under both displacement and load control
Nanoindenter	**Nanotest 600** **MicroMaterials**	**INSTM** **Prof. J.M. Kenny** Nanocomposite,organic and inorganic polymers, antique ceramics, epoxy resins, PP, PVC, PMMA, PCL, steels, aluminium alloys	-Nanoindentation (Berkovitch diamond tip) to measure hardness and Young modulus -Scratch test (Rockwell diamond tip) to measure the adhesion between thin film and substrate
Ball Drop Impact Tester	**equipment laboratory made**	**INSTM** **Prof. J.M. Kenny**	It is possible to collect all the information regarding the impact acceleration and the impact load on the supports during impacts lasting a few milliseconds.

SORPTION, DIFFUSION, PERMEATION

Gas Permeameter	**OXTRAN 2/21 MH and 2 home made permeation equipments using a pressure transducer**	**UCLB** **Eliane ESPUCHE** study of the gas transport mechanisms in polymer, composite, nanocomposite films	Determination of the gas permeability and diffusion coefficients
Sorption apparatus	**Setaram microbalance**	**UCLB** **Eliane ESPUCHE** the water transport mechanisms in polymer, composite, nanocomposite films	Determination of the water uptakes and of the water diffusion coefficients in a large range of activity
Barometric Diffusion and Permeation Measurements	**Lab-made device**	**CSIC** **Dr.Pilar Tiemblo, Dr.Julio Guzmán** Diffusion and permeation coefficients in polymers and polymer based composites	Diffusion and permeation coefficients of gases in the temperature range 5ºC-45ºC and in pressure range 0.3 bar to 3 bar.
Osmotic procedure for the achievement of nanostructured polymers	**Laboratory Set-up (patent pending)**	**INSTM** **Prof. Maria Vittoria Russo** - Catalytic co-polymerizations - Emulsion polymerizations and co-polymerizations - Polymerization of organometallic polymers - Immobilization of biomolecules on nano-polymers	- Improvement of the catalytic performance of proteins employing the specific interactions between support and protein; - Adsorption of pharmaceutical or bio-active molecules on nanostructured carriers with improved activity for the molecular targeting; - Preparation of biopolymers for the delivery of cosmetic molecules

OPTO-ELECTRONIC PROPERTIES (1)

Fluorescence specroscopy	**Spectrofluorimeter model FLUOROLOG3-11 with microscope** **Jobin-Yvon**	**TUL** **Prof.Barbara Wandelt** - Standard Fluorescence spectra - Thin-layer polymeric films, gels, biological objects - Specific spectroscopy measurements for microscopically selected objects	- Standard Fluorescence spectra - Thin-layer polymeric films, gels, biological objects - Specific spectroscopy measurements for microscopically selected objects
Auger Electron Spectroscopy (AES) / X-Ray Photoelectron Spectroscopy (XPS)	**MICROLAB MKII** **V.G. Scientific**	**INASMET** **José Luis Viviente, *Researcher*** - Biological, biomaterials and biomedical fields. - Tunnel effect: application in nanotechnology, bionanotechnology and nanomaterials.	- Physic and chemical properties of materials in a superficial level - Solid samples surfaces extracted from different materials electrically conductive: metals, ceramics, composites, fibres, materials with different surface treatments, etc. - Thin films of greasy or other compounds

OPTO-ELECTRONIC PROPERTIES (2)

UV-VIS-NIR	**Spectrometer model Carry 5000 (Varian Inc.)**	**TUL** **Dr.Marcin Kozanecki** Investigation of the polymeric materials	- The solid and liquid materials - Measurements in polarized light - The transmitance and reflectance analysis of samples which highly disperse light - The specular reflectance analysis for various angels
System for thermoluminescence measurements with spectral analysis of the emitted light in temperature range10 K - 330 K	**Micro HR Imaging Spectrograph CCD Camera,** **Horiba Jobin-Yvon**	**TUL** **Dr.Ireneusz Glowacki** Polymers and polymeric composites films	- The charge carries trapping /detrapping and radiative recombination processes in organic materials - Estimation of the energy depth traps - Spectral analysis of the emitted light and identification of the recombination centres in organic blends.
System for simultaneous thermoluminescence and thermally stimulated current measurements in temperature range 77 K - 450 K	**Micro HR Imaging Spectrograph CCD Camera,** **Horiba Jobin-Yvon,**	**TUL** **Dr.Ireneusz Glowacki** Polymers and polymeric composites films	Simultaneous thermoluminescence and thermally stimulated current measurements measurements in polymeric and polymeric composites films
System for electroluminescence measurements	**Micro HR Imaging Spectrograph CCD Camera, Horiba Jobin-Yvon , Minolta CS200 ChromaMeter**	**TUL** **Dr.Ireneusz Glowacki** Electroluminescence measurements in organic materials	- Recording of the electroluminecence spectra - Estimation of the Internal quantum efficiency - CIE 1931 colour coordinates
Electrical conductivity measurements in broad temperature range	**Lab made system**	**TUL** **Dr. Jaroslaw Jung** **Dr.Ireneusz Glowacki** Polymeric systems	I-V characteristics for polymeric systems

OPTO-ELECTRONIC PROPERTIES (3)

Semiconductor characterization system	**Keithley 4200 SCS**	**INSTM** **Prof. J.M. Kenny** Carbon nanotubes alone or in nanocomposite, organic molecules photovoltaic devices, surface plasma treatment, functional nanocomposites	-Two probes electrical measurements -Transistor configuration measurements
Xerographic discharge	**Lab made system**	**TUL** **Dr. Jaroslaw Jung** - Xerographic discharge measurements, - The electrical field dependencies of the photogeneration quantum yield, - Verification of theoretical fotogeneration models, - The recombination phenomena.	Calculation of the photogeneration quantum yield (determine by this technique) from the measured photodecays taking into account corrections for the light source performance, spectral characteristic of the optical path and absorption by the active area of the sample.
Microslit Electrokinetic Set-up (MES)	**electrokinetic (streaming potential/current) measurement system**	**IPF** **Dr. Ralf Zimmermann** Characterization of electrosurface phenomena at polymers in aqueous solutions	Study the charging of polymers in aqueous environments. The zeta potential provides the information about the charge formation process at the interface. By the determination of the surface conductivity information about the accumulation, distribution and mobility of access ions at the interface are obtained.

MAGNETIC PROPERTIES

Magnetometry	**Vibrating Sample Magnetometer ML-VSM9 MagLab 9T, Oxford Instruments**	**CSIC** **Dr. Jaime Martín Pérez**	Magnetic Hysteresis Loops, Saturation magnetization, Remanence, Coercive field, Magnetic anisotropies, etc.