ENERMAT Laboratories Description

Research Themes and Groups

Techniques and Equipment

Partnerships

Second Edition, March 2012

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CICECO

CENTRE FOR RESEARCH IN CERAMICS AND COMPOSITE MATERIALS

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Director: João ROCHA - rocha@ua.pt

Skills:
CICECO-University of Aveiro is the largest Portuguese institute in the field of materials science and engineering with the mission to 'develop the scientific and technological knowledge basis required for the innovative production and transformation of ceramics and composite materials'.
CICECO comprises 50 academic staff, 35 full-time researchers (42% non-Portuguese), 54 post-doctoral associates (49%), 82 PhD students (26%) and ca. 115 other students, having extensive skills in materials synthesis, and processing, modelling, structure and properties characterisation.
CICECO encompasses six research groups:

Group 1: Inorganic Functional Nanomaterials and Organic-Inorganic Hybrids
Group 2: Multifunctional Ferroic Ceramics and Nanostructures
Group 3: Materials for Energy Conversion and Storage
Group 4: Carbon Materials, Composites and Functional Coatings
Group 5: Biorefineries, Biobased Materials and Recycling
Group 6: Biomedical and Biomimetic Materials

Areas of Research:
CICECO research is organised in three research lines running across University of Aveiro's Departments of Chemistry, Ceramics and Glass Engineering and Physics:

LINE 1: Advanced Micro- and Nanostructured Materials for Information and Communication Technology
LINE 2: Materials for Energy and Industrial Applications
LINE 3: Sustainability and Bioaterials

Partnerships:
CICECO has developed many R&D projects and service contracts with companies from different industry sectors (using EC industry Sectors nomenclature):

- Aerospace industries
- Automotive
- Biotechnology
- Chemicals

- Construction
- Electrical engineering
- Food industry
- Healthcare Industries
- Information and communication technologies
- Legal metrology and pre-packaging
- Mechanical engineering
- Mining, metals and minerals
- Pressure equipment and gas appliances
- Radio and telecommunications terminal equipment (R&TTE)
- Wood, Paper, Printing

CICECO has also several privileged academic partnerships, some of them resulting from European initiatives and networks of excellence, for example, the European Multifunctional Materials Institute – EMMI (http://www.emmi-materials.eu/).

Techniques and Equipments:
Within CICECO, the Centre for Imaging and Structural Studies houses a range of advanced equipment, among others:

- Electron Microscopy - CICECO is a Pole of the Portuguese Electron Microscopy Network (RNME): TEM (High resolution), SEM and AFM, including a Piezoelectric Force Microscope;
- Nuclear Magnetic Resonance - CICECO is a Pole of the Portuguese National Nuclear Magnetic Resonance Network (PTNMR): top liquid (300 and 500 MHz) and solid-state (400 and 500 MHz) nuclear magnetic resonance facilities (including LC-NMR) and soon, 700 MHz for solids and liquids.
- X-Ray Diffraction (single crystal, powders and films);
- Photoluminescence Spectrometry (10-300 K);
- Magnetic measurements
- RAMAN and FTIR;
- Thermal Analyses (DSC, DMA, TGA and DSC/TG);
- Gas Adsorption Lines;
- Gas Chromatography;
- Pilot Installation:
    - Atomizer;
    - Ball mill and press filter;
    - Gas furnace;

CICECO has also access to EPR and mass spectrometers (MALDI-TOF/TOF, Q-TOF, Linear trap, nano-hplc, triple quadrupole).

Proposal offers for collaborations:

- Collaborative research (promotion of fundamental R&D, development of applied research, design of new products, improvement of the production system, life-cycle analysis, sustainable processes and products, identification of emerging technologies and creation of scientific know-how);
- Expertise/consultancy;
- Promotion of technology transfer:

    - Innovation management, promoting actively the development of R&DT projects in partnership with companies;
    - Promotion and support of entrepreneurship activities;
    - Promotion of IP protection and commercialisation;
- Training:
    - Courses;
    - Seminars;
    - Workshops;
    - Graduate Courses (design and promotion of advanced M.Sc. and Ph.D. programmes);
- Supply of Services namely: analysis, testing, scientific and technical reports, technical assessment, etc.

CIMAP

CENTRE DE RECHERCHE SUR LES IONS, LES MATERIAUX ET LA PHOTONIQUE

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Skills :

Research Centre on Ions, Materials and Photonics, CIMAP is a joint Laboratory between CEA, CNRS, Caen High Scool of Engineering (ENSICAEN) and the University of Caen.
Ion-matter interaction and materials for optical and photonic applications are its main research programs.
Interdisciplinary researches are also carried out at the National Large Heavy Ion Accelerator (GANIL - Grand Accélérateur National d'Ions Lourds).

Areas of Research:

Research Staff:

- Atomes, Molecules and Aggregates
- Simulation
- Materials, Defaults and Irradiations
- Integrated Nanostructures for microelectronics and photonics (NIMPH)
- Materials and laser instrumentation
- Lasers, Optical Instrumentation and applications

Know-how:

- Stability of biomolecules upon irradiation by mass spectrometry
- Origin of structural modification mechanisms caused by irradiation
- Defaults and interfaces of microscopical structures by high-resolution electron microscope
- Polymers deterioration under swift heavy ion irradiations
- Fabrication of crystals or thin films for laser applications
- Study of optical or electrical properties of materials and thin films

- Studying and characterization of Si-based nanostructures compatible with the CMOS technology for photonic applications
- Optical laser measurements

Partnerships:

Participation to European networks: ITS-LEIF (Ion Technology and Spectroscopy at Low Energy Ion Beam Facilities), LANCER (Light Amplifiers with Nanoclusters and Erbium), RAINBOW (Networks for Initial Training: Intrinsic Properties of InN and Indium-rich III-Nitride Alloys)
International collaborations: ITS-LEIF network, University of Stockholm, University of Ilmenau, University of Aarhus, Virginia University, University of Seoul, Pohang Institute of Science and Technology (Korea), Nanoscience Laboratory (Italy), McMaster University (Canada),…
Industrial collaborations: THALES, IOTA, ONERA, AREVA, TEEM Photonics, …

Member of the EMC3 (Energy and clean Combustion) Labex

Techniques and Equipment:

- Ion sources with different energies
- Irradiation and in-situ measurement experiments
- Fourier Transformed InfraRed and ellipsometry spectroscopies
- Ultraviolet-visible spectrophotometry
- Lasers (Saphir-Titane 890, Argon 2020-05, Krypton Innova 90K, YAG : Nd^{3+} SL903…)
- X-ray diffractometers
- Atomic Force Microscopy
- Scanning and transmission Electron Microscopy,
- Materials synthesis: magnetron sputtering, furnaces, crystal growth.

Proposal offers for collaborations :

- Collaborative research
- Services supply
- Consulting
- Training.

CNRT MATERIAUX
CENTRE NATIONAL DE LA RECHERCHE TECHNOLOGIQUE MATERIAUX

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Director: Alexandre WAHL - alexandre.wahl@ensicaen.fr

Skills:

The National Centre of Technological Research Materials is dedicated to strengthen a high level technological research partnership between research labs and industry, in the specific areas of functional and structural materials (materials for photonics, for catalysis, thermoelectric and composite materials....).

CNRT Matériaux offers:

- to develop a technological research in the field of materials on the initiative of the companies and on subjects clearly determined by them,
- to promote and to stimulate the technological transfer,
- to promote the emergence of regional, national and European projects between industry and laboratories.

Through the CNRT, companies can have access to a large set of equipments for either synthesis, processing and characterization. Full technical support and expertise can be devoted to industry's needs.

Research staff:

The CNRT Matériaux is gathering five research laboratories:

- Centre de Recherche sur les Ions, les Matériaux et la Photonique (CIMAP UMR 6252)
- Laboratoire de CRIstallographie et Sciences des MATériaux, (CRISMAT UMR 6508)
- Laboratoire de Chimie Moléculaire et Thio-organique (LCMT UMR 6507)
- Laboratoire de Catalyse et Spectrochimie (LCS UMR 6507)
- Laboratoire d'Ondes et Milieux Complexes (LOMC FRE 3102)

Know-how:

- synthesis, development and characterization of new materials for electronics
- development and study of mechanical properties of structural materials, particularly of composite materials and alloys
- synthesis, development and study of new polymer materials with remarkable biocompatible and biodegradable properties
- synthesis and development of new catalysts, study of the mechanisms at interfaces and validation of catalytic tests
- interaction between ion and material and of the relaxation of excited materials, defects in materials, materials for lasers, photonics

Partnerships:

- Participation in projects issued from Mov'eo, Astech, TES and EMC2 clusters.
- Participation in European/ International projects (ENERMAT, THETAGEN, ACTMOST)
- Industrial partnerships: Acome, PSA, SAFRAN, EDF, Renault, Valeo, Nexter, Setaram…

Techniques and Equipment:

- Spectroscopes (RMN, IR/UV/Raman,…) and diffractometer (powder, monocristal, grazing incidence)
- Thermal microanalysis equipment (ATG…)
- Gel Permeation Chromatography (GPC), Liquid Chromatography (LC)
- Electron microscopy (MEB, TEM…)
- Mechanical equipments (traction/compression/bending machines, damage monitoring by optical microscopy, temperature test chamber)
- Processing equipments (Resin Transfer Molding - RTM, injection, extrusion…)
- Sample preparation chamber (pulse laser deposition, sputtering, MBE laser), surfaces analyzers
- Several digital tools (for flow analysis in fibrous media, for analysis and optimization of Processes - Properties couplings, formatting software of composite materials)

Proposal offers for collaborations:

- Collaborative research
- Service supply
- Consulting
- Expertise
- Training

CRISMAT

LABORATOIRE DE CRISTALLOGRAPHIE ET SCIENCES DES MATERIAUX

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Director : Antoine MAIGNAN - antoine.maignan@ensicaen.fr
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Skills:

The CRISMAT researches are focused on both synthesis and study of materials with peculiar physical properties and, especially, oxides with magnetoresistance, ferroelectricity, thermoelectricity and magnetocaloric effects. The research skills are divided in six groups:

- Cristallography
- Oxides thin films
- New materials synthesis
- Ceramics and structural materials
- Solid state physics
- Microelectronics laboratory CNRS ENSICAEN-NXP Semiconductors (LAMIPS)

Areas of Research:

- Synthesis of oxides materials
- Structural characterization (X-ray diffraction, transmission and scanning electron microscopy with EDS analysis)
- Electrical and magnetic measurements from 2K to 1000K
- Thermogravimetric and differential thermal analysis
- Ceramics sintering
- Superconducting, dielectrics, magnetoresistive and thermoelectrics ceramics
- Microelectronics
- Micrometallurgy
- Thin films growth with pulsed laser ablation, resputtering and MBE
- Superconducting, ferroelectrics, magnetoresistive, thin films and multi-layers
- Ultra vacuum technology

Partnerships:

- Participation to competitiveness clusters (MoV'EO, TES et ASTECH)
- Participation of the CNRS research groups «multiferroics» and «thermoelectrics»
- Partnership or coordination of several FP7 EU research programs
- Several joint projects with companies: EDF, NXP, ACOME, Renault, PSA …
- Member of the EMC3 (Energy and clean Combustion) Labex

Techniques and Equipment:

- Physical properties measurement system (Quantum design)
- Isolatic press
- RX diffraction (powder, crystals, thin films) and thermal diffraction
- 5 Transmission electron microscopes equipped by EDS analyzers
- Mirror furnace
- Scanning electron microscopy with EDS analysis
- Pulsed laser ablation

Proposal offers for collaborations:

- Collaborative research
- Services supply
- Consulting
- Training.

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Skills:

The ICMCB is structured into 7 Research groups:

- Hydrogen, Fuel Cells, Thermoelectrics
- Materials for Batteries
- Materials for Optics
- Ferroelectrics, ceramics, composites
- Functionalised materials: Fluor, Hybrids, Nanoparticles
- Molecular Sciences: Piezo-, Photo-, Thermosensitive Materials
- Supercritical Fluids

Visit http://www.icmcb-bordeaux.cnrs.fr/us-icmcb/groupes/groupes.html for detailed presentations of the groups and their staff.

Areas of Research:

The ICMCB focuses on three research areas: Solid State Chemistry, Materials Science and Molecular Science.

Partnerships:

Due to the interdisciplinary character of our research, we have developed numerous collaborations with physicists, geologists, biochemists and medical scientists, both national and international.

Our industrial partnership is also strongly developed. In collaboration with a number of large French and international companies, we search for new materials, or optimize existing ones, for current and future applications.

We also cooperate with many small and medium-sized enterprises (SME), typically in application related projects which aim to enable new technologies. Most of our SME partners come from the Aquitaine Region of France, and the ICMCB has succeeded in the creation of a number of start-up companies.

Successful research depends on experience and know-how, but also on creativity and enthusiasm. The ICMCB thus aims to maintain a blend of experienced and young researchers. Education of young scientists for academic and industrial research remains one of our central activities. Producing graduates of the highest quality especially for industry is an essential contribution to a modern knowledge-based society.

As a consequence of its wide-ranging activities in materials research and education, the ICMCB is an active partner of several networks in the Aquitaine Region and on a European level:

- Materials and Systems Institute of Bordeaux (MIB)
- Regional Competitively Clusters AESE and Route des Lasers
- Regional Research Association (GIS) "Matériaux en Aquitaine"
- European Networks of Excellence Fame-EMMI, ALiStore, MagMANet and several EU research projects

The ICMCB is an important contributor to the strategic goal of the Aquitaine Region which aims to become an excellence cluster in Materials Research.

Techniques and Equipment:

In order to cover its wide field of materials research, the ICMCB has at its disposal all important techniques for chemical and physical characterisation of materials. Computer simulation has also become an important part of our research effort in recent years.
Notably we have extended expertise available in our 3 Resource Centres for Crystal Growth, Thin Films and High Pressure Synthesis.

See http://www.icmcb-bordeaux.cnrs.fr/us-icmcb/services/services.html# for details

Proposal offers for collaborations:

The ICMCB is open for discussion of new collaborations in all research fields mentioned above, notwithstanding commitments due to existing cooperations. For contacting us please make use of the contact named above, or contact directly the individual researchers which you can identify via our website.

IMS

LABORATOIRE DE L'INTEGRATION DU MATERIAU AU SYSTEME

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Skills:

- Organic electronics
- Microelectromechanical systems
- Nanoelectronics
- Reliability
- Design
- Automatic control
- Signal
- Production Engineering

Areas of Research:

The laboratory is divided into 4 groups:

Group 1 : "From Material to device"

- Organic Electronics
- Functionalized materials for telecommunication and optics
- Microassembled materials for microelectromechanical systems
- Acoustic wave devices for detection

Group 2 : "From device to system"

- Laser beam testing and analysis
- Assessment and reliability of microwave technologies
- Compact modeling and device characterization
- Reliability of electronic circuits
- Evaluation of micro and nanoassembled devices
- Packaging, assembly technologies and electromagnetic compatibility
- Power integration
- Integrated circuit design
- High frequency circuits and systems
- Digital circuits and systems

Group 3 : "From system to systems of systems"

- Model-based diagnosis, fault-tolerant control
- System identification, guidance and control
- Fractional-derivative systems
- Model-based approaches for 1-D to n-D signal processing
- Textured image modeling and analysis
- Applications to speech, biomedical, mobile communication, seismic data, material characterization and video*)*
- Model-based approaches for 1-D to n-D signal processing
- Textured image modeling and analysis
- Applications to speech, biomedical, mobile communication, seismic data, material characterization and video

Group 4 : "The systems and their interactions"

- Engineering of neuromorphic systems
- Electronic systems in interaction with biology

Partnerships

Collaborative research labs with companies

- STMicroelectronics (since 2004)
- "Analog and Mixed RF" & "Technology Modeling and Characterization"
- TOTAL (since 2001)
- Seismic imaging
- PSA and BOSCH ("Vehicle of Future" platform)
  Global Control of Automotive Chassis, Dynamic Identification of the Drivers
- THALES (since 10/2009)
- Design and Reliability of Embedded Systems for Aeronautics

Collaborative research labs with various academic laboratories

Techniques and Equipment:

Technology platforms

- Organic electronics
- Assembly technologies
- Analysis and characterization
- Power assembly
- Hybrid electric vehicles
- Global control of automotive chassis
- Dynamic identification of driver

ISM

INSTITUT DES SCIENCES MOLECULAIRES

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Director: Dr. Philippe GARRIGUES
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Skills :

The Institute of Molecular Sciences (ISM, UMR 5255 CNRS) of Bordeaux gathers a community of researchers focusing on fundamental and applied aspects of molecular science.

- Theoretical studies in quantum chemistry and molecular modeling.
- Multi-scale approach for materials.
- Design & molecular engineering (organic, organometallic, inorganic, sol-gel).
- Nanostructuration, self-assembly & nanoarchitectures.
- Material processing from liquid routes.
- Physical chemistry (spectroscopy, photochemistry, photophysics).

These recognized skills are applied towards advancing organic and hybrid organic-inorganic materials for plastics electronics and solar energy conversion.

Areas of Research:

- Theoretical modeling of the electronic processes involved in organic and hybrid electronic or opto-electronic devices.
- Design and synthesis of novel molecular precursors or nanobricks for functional materials (organic, organometallic, inorganic, sol-gel).
- Preparation and processing of new organic and hybrid organic-inorganic active layers and nanoarchitectures (bulk, self-assembled monolayers, thin films, arrays).
- Characterization of the active layers.
  (surface, morphology, texture, stability, electronic properties).
- Elucidation of photoinduced processes in nanostructured materials for organic electronics.
- Applications towards solar cells (organic and DSCs), transistors (OFETs), sensors.

Partnerships:

- ISM belongs to the CARNOT Institute “Material Institute of Bordeaux” (MIB, Materials and Systems), the network C-Nano “Grand Sud-Ouest”, the GIS “AMA” Advanced Materials in Aquitaine.
- International: European Interreg IV ENERMAT-aa (collaboration with Universities of Liverpool (UK), of Aveiro (Portugal), of Santiago del Compostela (Spain), of Caen (France)), European Doctoral School on Functional Materials (IDS-FunMat, 9

Partners), European Multifunctional Material Institute (EMMI), MINOTOR project on "Modeling of electronic processes at interfaces in organic-based electronic devices".
- Numerous collaborations with industrial partners, including ASTRIUM ST, RHODIA, ARKEMA, CIVB, DEMPTOS, POLYRISE, EOLITE, DU PONT.

Techniques and Equipment:

- Modeling centre (quantum, semi-empirical approaches, static and dynamic classical mechanics, databases, network of Linux PC, high performances calculators).
- High resolution solution and solid-state NMR spectrometers (Bruker Avance 300 & 600, DPX 200 & 400), high resolution mass spectrometer (Electrospray, MALDI-tof)).
- Thin film processing (spin-coating, dip-coating, screen-printing).
- State of the art UV-visible absorption, emission, FTIR and Raman spectrometers; Steady-state and time-resolved absorption and emission spectroscopies; cyclic voltammetry.
- AFM, confocal fluorescence microscopy, surface energy, spectroscopic ellipsometry.
- Mercury porosimetry, N_2 sorption analysis, Routine SEM, Thermogravimetry coupled to mass spectrometry (TGA-MS), DSC, powder X-ray diffractometer (Bruker D2 phaser).

Proposal offers for collaborations:

- Collaborative research.
- Research service provider through dedicated technological platforms.
- Consulting.
- Expert reports.
- Training.

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Skills :

Energy materials research is centred on the Department of Chemistry, rated 7th in the UK in the 2008 Research assessment Exercise (RAE). This stems from the core academic expertise in materials chemistry of inorganic and polymer systems in the groups of A.I.Cooper and M.J.Rosseinsky, and on the materials processing expertise in the group of P.R.Chalker (Engineering Materials Department).

Areas of Research:

- Low temperature ionic conductors for SOFC
- Transparent conducting oxides
- Catalysis and separation applications
- Oxide (photo) catalysts including supported metals.
- Clathrates and porous materials for gas storage
- Nanomaterials for biological labelling
- Imaging and therapeutic delivery
- Lead-free ferroelectrics, multiferrocies

- High k dielectrics for MOSFET applications
- Batteries
- Photovoltaics
- Biofuels
- Modelling and Simulation

Partnerships:

The Knowledge Centre for Materials Chemistry (KCMC) is a virtual centre of expertise providing multi-disciplinary research and innovative knowledge transfer based on world class capabilities in applied materials chemistry.

The KCMC provides a single point of contact for companies of all sizes to access a substantial range of facilities and expertise in applied materials chemistry at four leading academic institutions at Bolton, Liverpool and Manchester Universities and the Science and Technology Facilities Council at Daresbury.

KCMC currently has 100+ active or completed projects with industry partners. Of these roughly 40% are energy related, either with companies in the supply chain or end users.

In addition to working with the KCMC, the University also has several long standing relationships with a range of large multi-national companies.

Stephenson Institute for Renewable Energy:

The Stephenson Institute for Renewable Energy is a recently-founded interdisciplinary research institution within the University of Liverpool's School of Physical Sciences, which will play a leading role in renewable energy research.

The Institute brings together energy-related research activities from across the University to focus on developing clean and sustainable energy technologies. To date research groups include expertise in photovoltaics, batteries, biofuels, semiconductors, fuel cells and hydrogen storage.

In addition to its research programme, the Stephenson Institute allows students and postgraduates to work on energy-related projects and technologies providing them with relevant skills and knowledge to meet the UK and global demand for graduates in this emerging job market. The Institute will develop expert networks, including policy-makers and management, to highlight global energy and sustainability issues.

The Stephenson Institute is a member of the European Platform of Universities Engaged in Energy Research (EPUE).

Techniques and Equipment:

Ultra Mixing and Processing Facility (UMPF)

Emulsions offer an important product delivery format, across many product sectors (personal care, food, pharmaceuticals, paints). The University's Ultra Mixing and Processing

Facility (UMPF) provides a unique world class facility to explore how alternative emulsion processing regimes can reduce energy consumption and help minimise feedstock raw materials.

Pressures by orders of magnitude higher than those used in previous mixing technologies (up to 5000 bar), combined with clever modifications of the operational modes and geometries of conventional rotor-stator devices (with speeds upto 50,000 rpm), give this facility the leading edge that will set new standards in fluid processing. The facility has been developed in conjunction with a process equipment manufacturer and large multi-national company.

Centre for Materials Discovery (CMD)

The Centre for Materials Discovery (CMD) works with a wide variety of both academic and commercial collaborators, utilizing generic principles in methodology and practice to facilitate research across a range of industrial sectors and academic fields. Research encompasses new products, new material applications, and fundamental developments in materials synthesis.

CMD uses state-of-the-art robotics and automation technologies for the accelerated discovery of new functional materials in applications such as energy, health, home and personal care, and many others. A multidisciplinary team of scientists supports and delivers research in the Centre, facilitating the discovery and optimization of new materials for future commercial exploitation, and ensuring that work on new projects can start quickly.

Atomic Layer Deposition (ALD)

ALD is a thin film deposition technique which is used for the deposition of oxides, nitrides, sulphides and metals layers. It is based on the sequential pulsing of precursor chemicals that react with the surface one at a time, depositing a small amount of materials in each cycle. Self limiting precursors allow the same amount of material to be deposited in each reaction cycle. The thickness of the deposited film depends on the number of cycles and allows conformal thin films to be deposited. Repeating the ALD cycles allow a thin film to be deposited.

The University has a number of different ALD reactors which allows doping of films and multilayer coatings for a wide range of applications, e.g. solar, semiconductor and catalysis.

energy materials &
clean combustion center

LabEx EMC3

Contact : Antoine MAIGNAN - antoine.maignan@ensicaen.fr

Skills:

Two major themes are present in the Labex EMC3: materials for energy and clean combustion. The “materials for energy” theme covers a large area ranging from materials for energy recovery, reduced power consumption, safety of nuclear installations with, in many cases, the development of new materials by eco-compatible methods. The theme of “clean compatible combustion” deals with the improvement of fuel and combustion, decontamination of exhaust gas and waste heat recovery.

Areas of Research:

The scientific scope of the centre is defined around the following themes:

- **Materials for energy**
  - Thermoelectric materials
  - Materials for light emission
  - Materials for nuclear energy
- **Clean combustion**
  - Alternative fuels and blends
  - Combustion
  - Post-treatment of effluents and decontamination treatment
- **Instrumentation, Optical diagnostics and advanced lasers**
  - Spectroscopy
  - Development of laser sources dedicated to diagnostics applications
  - Nano characterization of materials

Partnerships:

University of Caen, University of Le Havre, University of Rouen, ENSICAEN, INSA of Rouen, CNRS (INC, INSIS, INP), CEA (DSM).

Techniques and Equipment:

Atomic scale characterization facilities - electronic microscopy for transmission and tomographic atomic probe, thermoelectric generators prototyping facilities, operand spectroscopic characterization setup, devices for materials irradiation, clean room, test facilities for aeronautics, industrial and automotive combustion.

LBTS

LABORATORIO DE BAJAS TEMPERATURAS Y SUPERCONDUCTIVIDAD

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Skills:

- Growing, characterization and study of advanced materials for the energy, mainly high-Tc superconducting materials.
- Implementation of new technological devices based on advanced materials, mainly superconductors (fault current limiters).

Areas of Research:

Low and high-Tc superconductors (electrical transport properties). Application to massive current transportations and thin films superconducting microlimiter for electronics.

Partnerships:

- Group of Superconductivity of CRISMAT-ESICHEN 14050-CAEN, France.
- Group of Superconductivity of the École Normale Supérieure de Paris, France.
- Instituto de Fisica, Universidade Federal do Rio de Janeiro, Brazil.
- Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China.
- Group of Superconductivity of the University of Vigo, Spain.

Techniques and Equipment:

- Systems to grow different bulk low-Tc and hig-Tc cuprate superconductors.
- Optical and electronic lithography.
- Optical, electronic and AFM microscopy.
- Cryogenic equipments and experimental systems allowing to measure with ultra high resolution different electric and thermal properties in the dc, ac and pulsed (up to nanoseconds) regime, up to 0.5K, under magnetic fields up to 16 T, and with electrical currents up to 100 A.
- Two SQUID magnetometers (from 0.1 K up to 800K, and under magnetic fields up to 7 T).

Proposal offers for collaborations:

- Research collaboration
- Provision of a service
- Consulting
- Report
- Training

LCMT

LABORATOIRE DE CHIMIE MOLÉCULAIRE ET THIO-ORGANIQUE

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Director: Annie-Claude GAUMONT
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Skills

The LCMT research axes are focused on molecular and macromolecular chemistry. The main skills of the lab are:
- The synthesis and characterization of molecule and macromolecules
- The modification of synthetic polymers and bio- polymers for specific properties
- The tailoring of the chemical and physical properties of organic and hydrid materials and nanocomposites.

Areas of Research:

• Preparation of new phosphorus, sulfur or fluorine containing organic molecules and macromolecules for applications in the field of medicines, agrochemicals, catalysis or materials.
• Development of greener catalysts (organic and organometallic ones).
• Synthesis of tailor made ionic liquid for various purposes (solvents, templating agents, supported catalysts, fuel cells …).
• Preparation (synthesis and characterization) of new organic materials with specific properties (organic polymers, organic conductors…), hybrid materials and composites.
• Microwave, ultrasonic and continuous flow technologies.

Partnerships:

• Coordination of an Interreg IVa Program (ISCE : Chem) aimed at creating a synergy between institutions of higher education and research of Normandy and South / South East UK (Southampton, Norwich), and with industrial partners located in these Regions.
• Several joint projects with companies: ORIL, L'Oreal, PCAS, Wagon Automotive, Hutchinson, Adisseo, AERAZUR, VIVADENT, CARGILL….
• Participation to competitiveness clusters (MoV'EO, Pharmavalley…)
• Participation to the CRUNCH (Interregional Network in Chemistry) aiming at developing collaborative projects between the 2 Normandies.

• Member of the EMC3 (Energy and clean Combustion) and SYNORG (Organic syntheses) Labex
• Joint projects with academic partners in UK, Poland, Japan, Australia, Italy…

Techniques and Equipment:

• Two liquid NMR spectrometers with 400 and 500 MHz superconductive magnet
• Chromatography platform (4 analytical HPLC chains, 1 semi-preparative HPLC and 2 Gaz chromatography devices).
• Mass spectrometry service (GC / MS and LC / MS QTOF)
• CHNS elemental analysis device
• Infra Red (ATR mode and in situ device), UV and fluorimeter X devices
• Single-crystal X-ray CCD diffractometer
• Solvent generator and a glove box
• Capillary electrophoresis
• Microwaves devices
• Continuous flow device
• Platform for shaping and organic or hybrid materials characterization (mini injection press, mini extruder, Lyoph, sCO2 dehydrator, SEC, DSC, TGA, Corona powder coating device, Mini - Film casting device....)

Proposal offers for collaborations:

- Collaborative research
- Service supply
- Consulting
- Expertise
- Training

LCPO

LABORATORY OF ORGANIC POLYMER CHEMISTRY

UMR 5629

RESEARCH GROUP : POLYMER ELECTRONIC MATERIALS AND DEVICES

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Director : Henri Cramail
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Skills :

- Design and synthesis of functional polymers and copolymers for applications in optoelectronics, displays and medias
- Development of copolymers as additives for photovoltaic applications
- Synthesis of semi-conducting latexes
- Formulation of electronic inks for transparent conductive films
- Characterization and optimization of nanostructured donor/acceptor bulk heterojunctions
- Physical-chemistry of polymers and copolymers

Areas of Research:

- Flexible Organic Photovoltaic
- Flexible Displays
- Flexible Electronics
- Organic Light Emitting Devices
- Organic Electronics
- Lithography and nanostructured recording media

Partnerships:

- Arkema
- ARMOR
- Hutchinson
- CEA-INES
- Academics : University of Bordeaux (IMS, ISM, ICMCB, CRPP), University of Marseille (IM2NP), Ecole Polytechnique (LPICM), University of Lyon (IMP), Fraunhofer Institute for Photonic Microsystems (IPMS) in Dresden

Techniques and Equipment:

- **POLYMERIZATION REACTIONS**
  - Supercritical reactor (scCO2)
  - Reactor for ethylene & propylene
  - High pressure reactors (gas)
  - Glove boxes
  - Stop-flow

- **MOLECULAR DIMENSIONS**
  - Osmometer (Osmomat 090 Gonotec)
  - Tonometer
  - Capillary viscometer (CK 300, Schott)
  - SEC (H_2O, THF fast/slow, DMF) (RI, UV & LS detectors)

- **MOLECULAR STRUCTURE**
  - NMR: 1H, 13C & other nuclei (400 MHz)
  - 2 FTIR (Thermofisher, Brüker)
  - UV-Vis Spectrometer (Cary 3E, Varian)
  - UV-vis Spectrometer Fluorimeter
  - Access to 3 Mass spectrometers (1 MALDI-TOF) (located at CESAMO)

- **MORPHOLOGY (LIQUID and SOLID STATES)**
  - SAXS (Nanostar)
  - Small-angle light scattering DLS & SLS (ALV, multi-angles)
  - Zeta -sizer (Malvern 90°C and back scattering)
  - Dimension Icon AFM (Veeco)
  - Access to microscopies: TEM, MEB and AFM
  - Fluorescence and phase contrast microscopes

- **THERMOMECHANICAL PROPERTIES**
  - DSC Q100 TA Instruments with t/T modulation
  - DMA Imposed strain RSA 3 TA Instruments
  - 2 Imposed stress Rheometers (RS300 Thermoelectron, AR2000 TA Instruments)
  - Dynamometer (Instrom)
  - Isothermal titration calorimetry 200 (microcal) & nanoITC (TA Instrument) (located at CRPP)

- **FORMULATION**
  - Spin-coater
  - Micro-extruder (DSM)
  - Injection press (DSM)

LCS

LABORATOIRE CATALYSE ET SPECTROCHIMIE

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Skills

While activities of the lab evolved over the years, as Catalysis and Spectrochemistry worldwide moved ever closer with the advent of the so-called "Operando Spectroscopy", the main thrust of the LCS has always been the "Molecular Understanding of the Working Catalyst".

The Catalysis and Spectrochemistry Laboratory (LCS) is a joint lab between CNRS and ENSICAEN. With 60 people, it prepares and studies solid catalysts for applications in the in the domain of automotive exhaust treatment, energy production (oil refining and biofuels) and biosourcing of chemistry. LCS is well known for the operando characterization of the catalytic reaction, which is the observation of chemistry inside the reactor, with the living catalyst at work. It was reinforced recently in the field of preparation and synthesis of porous nanomaterials. The LCS has strong collaborations with other academic labs (Lille, Poitiers, Lyon, Lisbon, Valencia, Zurich...) and industries (Total, PSA, IFP-EN, Rhodia, Evonik, Grace, Toyota, Michelin, ...), and founded the "European Laboratory for Zeolites and Parent Materials" with the University of Leuven (Belgium). Within LCS, LCS-Valoris offers analyses and chemical measurements as a commercial service.

The LCS is organized around 3 themes:

CATEC: Catalysis for Energy and Chemistry
CATEC deals with the optimization of fossil and renewable sources for the production of fuels and main chemical intermediates with an improved environmental footprint. Projects take advantage of specific expertise in LCS: spectroscopy for the characterization of interface (acidity and basicity, metal sites...), in situ and operando methods, kinetics, and materials developed by the "porous material" theme. One of the main aims is to determine structure/activity relationships, to identify active sites and reaction mechanisms, and to understand deactivation processes.

Porous Materials: from Preparation to Advanced Applications
We are focused on the preparation, the characterization and the use of zeolites and parent porous materials with improved properties in the traditional applications fields such as heterogeneous catalysis and separation processes, but also in new applications. Our research combines two independent topics which are the design of new materials and the

development of their applications. This combination is achieved using advanced characterization techniques for understanding and improving the physical and chemical properties and for a rational design of the final material. Methodology and design of new characterization methods for porous materials is thus a key aspect of our approach.

Surfaces and Environment

Research in this domain deals with the surface properties of powdered solids, with a particular focus on the adsorption and catalytic sites on solids. The main characterization technique is infrared spectroscopy of adsorbed probe molecules, with complementary techniques such as Raman and UV together with test reactions. Applications are in chemistry for environment. We want to understand processes by studying reactors in real working conditions (operando study) to determine active sites, reaction intermediates and deactivation mechanism. Our objective is to propose improvements in the formulation of the solids. This needs a strong focus on methodology to improve time and space resolution in characterization.

Areas of Research:

CATEC

- **Clean and efficient fossil fuels**

(Hydro) desulfurization of fossil fuels, Catalytic cracking with or without incorporation of biomass, Isomerization of alkanes, opening cycles

- **Synthetic fuels**

Fischer Tropsch synthesis, Gas reaction to water

- **2nd generation biofuels**

HDO of pyrolisis oils, Fischer Tropsch synthesis

- **Bio-sourcing of chemical intermediates**

Guerbet condensation, Valorisation of glycerol, aldolisation of oxygenated molecules derived from biomass

Porous materials

- **Porous materials engineering**

Micro- and nano- sized zeolites and other nanoporous materials
Porous films, single or multilayered, self supported 3D porous solids
Functionalized porous materials
Hierarchical porous structures, with applications in catalysis, separation, gas and liquid sensing, optics, membranes for gas and liquids

- **New processes and methodology**

Fast time resolved spectroscopy for short lived chemical species
Characterization of viscous liquids and colloids
New energy transfer methods (µwaves, plasma)
In situ and operando techniques (PJAS, CF-RMN, operando IR, RAMAN and UV-Vis, AGIR).
Data treatment and analysis (2DCOS, 2DFFT, maximal entropy, spectral inversion, PCA and chemometry)

Surfaces and Environment

- **Solids**

Transition metal oxydes, supported metals and porous solids (zeolites and MOFs), with a high specific surface.

- **Applications in chemistry for the environment**

Exhaust treatment for stationary or mobile sources (NOx, SOx, VOC, soots...)
Air and gas treatment (traces of CO and CO2 in hydrogen, PROX,...)
Hydrocarbon separation, new energetic media (H2), valorisation of CO2

- **Methods**

New probe molecules for specific analyses
Time and space resolved spectroscopy
Operando methodology

Techniques and Equipment:

- 20 IR Spectrometers for « in situ » or “operando”,
- 1 Raman Spectrometer for « in situ » or “operando”,
- 1 NMR (400 MHz) for « in situ » or “operando”,
- 1 UV-VIS Spectrometer,
- Model Molecules Testing (> 50 bar, S & S-free)
- Textural & Thermal Analysis (BET, TG/DSC,….)
- Zeolithes synthesis and processing

Homemade tools: IR cells, operando NMR, IR Spectrometer.

Proposals offers for collaborations:

Services:

- analysis
- development and improvement of products and processes
- resolution of specific problems
- feasibility studies
- training
- expertise
- interpretation of results

LCSValoris helps to provide the industry expertise and achievements of the laboratory while providing the flexibility, speed, responsiveness, availability and tracking of a private company.

Partnerships:

Participation to European networks:

- Laboratoire Européen Associé (LEA CNRS) with the Centre for Interface Chemistry and Catalysis, KULeuven (BE)
- MACADEMIA – Metal Organic Frameworks in Industry

International collaborations:

- ETH Zurich (CH), DNL Dalian (PRC), IST Lisbon (P), LMU Munich (D), Cambridge (UK), PNNL (USA), NIC Ljubljana (SLO), ...

Industrial collaborations:

- **France:** Total, PSA, IFPEn, Rhodia, Michelin, Valeo, Filtrauto
- **International:** Evonik, Grace, Toyota,...

Member of the EMC3 (Energy and clean Combustion) Labex.

MIRIADE

MISSION RÉGIONALE POUR L'INNOVATION ET L'ACTION DE DÉVELOPPEMENT ECONOMIQUE

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Mission

MIRIADE is the Regional Agency of Basse- Normandie created by the Regional Council in 2007. Its mission is to help enterprises and research centres to build up innovative projects and improve territorial competitiveness.

- Support innovative projects of companies from Basse-Normandie
- Promoting territorial development by helping education, research and economic actors in the setting up of collaborative projects Promouvoir et coordonner l'innovation en région
- Coordinating the network of innovation actors
- Strengthen the presence of Basse-Normandie actors in European Projects

Two main areas of activity

- **Economic development and internationalization** :
  - Support to Industry and Clusters,
  - Coordination of the network of innovation actors,
  - strategic monitoring.
- **Ingénierie de projets :**
  - Collaborative projects (laboratories/entreprises),
  - Entrepreneurial Projects (development/innovation),
  - European Projects

PIONEER OF R&D AND B2B GATEWAYS IN THE BASSE-NORMANDIE REGION…

To improve collaborations between researchers and industrials, the MIRIADE has created "LES PASSERELLES" (gateways), one-to-one meetings on the basis of the speed-dating model (with a specific timeframe, space and theme).

Since 2007, The MIRIADE has organized 30 gateways (“PASSERELLES”) in the Region Basse-Normandie, for a total of 1300 one-to-one meetings and 80 collaborative projects.
In 2010 they created as well the “Projects Factory”, thematic meetings that bring ideas identified during “the passerelles” to projects setting up.

supported by

ATLANTIC AREA Transnational Programme
INVESTING IN OUR COMMON FUTURE

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academic partners

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