RESEARCH LABORATORIES

If you are interested by a research project, please send an email to the CONTACT PERSON of your choice , and put the international Office in copy (international@ensc-lille.fr)

2017

UNIT OF CATALYSIS AND SOLID STATE CHEMISTRY

http://uccs.univ-lille1.fr/

Director : Prof. Franck Dumeignil (franck.Dumeignil@univ-lille1.fr)

Phone : + 33 3 20 43 45 38
Address:
Université de Lille, Bâtiment C3
59650 VILLENEUVE D'ASCQ

Department 1 : SOLID STATE CHEMISTRY

Head of Department: Dr. Pascal ROUSSEL (pascal.roussel@ensc-lille.fr)
Phone: + 33 3 20 43 4899
Address :
École Nationale Supérieure de Chimie de Lille
C7 Building
59652 VILLENEUVE D'ASCQ CEDEX

Research Fields:
Solid State Chemistry (ceramics and glasses)
Ionic, electronic and mixed conductors
Mixed Valence Materials
Electrochemical separation of oxygen gas
Chemistry of actinides
Trapping of radionucleides
Metal-organic frameworks
Precursors and new routes for oxide synthesis

Scientific equipment:
X-ray diffractometers (for powder, single crystal and thin film) under controlled atmosphere and variable temperature (from 80K to 1500K)
Solid State NMR (from 100 to 900 MHz)
Raman, UV-Vis and Infrared spectrometers
Electron microscopy (Scanning and transmission)
Thermal Analysis (TGA, TDA, DSC, TMA, etc…)
Electrochemical Impedance Spectroscopy
Many Synthesis facilities (preparation and furnaces)
Isotopic exchange (O^{17} and O^{18})

Keywords :
Chemical synthesis (new routes)
Glasses and Ceramics
Methodology and Advanced Structural Characterization
Magnetic, Electric, Optical, Ionic and Electronic properties

Main fields of applications:
Energy and Environment
Energy storage and savings
Electrochemical devices
Nuclear combustible cycle
Self-healing glasses

Department 2: HETEROGENEOUS CATALYSIS

Head of Department: Prof. Carole LAMONIER (carole.lamonier@univ-lille1.fr)
Phone : + 33 3 20 43 49 50
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Research Fields:
Novel synthesis of ordered mesoporous functionalized catalysts with controlled nano- sized metallic and oxidic particles.
Advanced surface analysis and operando spectroscopic characterization
Molecular modelling and reaction mechanisms
Chemical engineering kinetics and reactor modelling, structured reactors, powder technologies
All those competencies are profitably used in various practical applications dedicated to the production of clean fuels (hydrotreating and Fischer-Tropsch reactions), biomass and light alkanes conversion for the production of valuables intermediates and environmental catalysis (deNO_x, deN_2O, COV)

Scientific equipment:
Surface analysis: XPS/LEIS/Tof-SIMS coupled to a catalytic cell working under controlled atmosphere up to 800°C.
Raman and infrared spectrometers for in situ and 0perando investigations
Thermal analysis (Thermogravimetry, DSC TPR/TPO, adsorption/desorption of probe molecules)
Catalytic reactor (CSTR, plug flow slurry reactors running under atmospheric at high pressure with online analytical systems.
Devices for the preparation and analysis of powder catalysts.
Realcat Plateform : High-throughput experiments from the preparation to the evaluation of the catalytic properties
Catalysis pilot Hall designed for pre-industrial catalytic processes

Keywords:
Hydrocarbon activation, biomass conversion, Fischer-Tropsch, hydrotreating reaction catalytic depollution, molecular modelling, surface analysis, catalyst preparation.

Main fields of applications:
Petrochemistry, fine chemistry, energy production, atmospheric pollutant abatement processes

Department 3: CATALYSIS AND MOLECULAR CHEMISTRY

Head of Department: Prof. Véronique RATAJ (veronique.rataj@univ-lille1.fr)
Phone: + 33 3 20 33 63 69
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Université de Lille
Bâtiment C6
59655 VILLENEUVE D'ASCQ CEDEX
École Nationale Supérieure de Chimie de Lille Avenue Mendeleïev Bâtiment C7a
BP 90108 59652 VILLENEUVE D'ASCQ CEDEX

Research Fields:
Synthesis and application of homogeneous organometallic catalysts
Hydrogenation, carbonylation, hydroformylation, C-C, C-O and C-N bond formation, oligomerization and polymerization
Organic synthesis
Surface organometallic complexes and catalysts
Supramolecular catalysis
Metallic nanoparticles
Polymerization catalysis
These research fields aim at applying homogeneous catalysis to the production of fine chemicals, clean processes, and polymeric materials
Oxidation catalysis
Microemulsions and emulsions
Design and physicochemical properties of biobased specialties
New conceptual tools and methods for formulation

Scientific equipment:
Catalytic reactors (high pressure autoclaves, multiclaves, polymerisation reactors)
Micro- and millifluidic devices
Glove-boxes and equipment for synthesis under controlled atmosphere
GC, GC-MS, HPLC chromatographs, UV/Visible spectrometer, FTIR, elemental analysis, NMR
Tensiometers, Nanosizer (DLS and zeta potential), DLS/SLS spectrometer, Laser granulometer, Rheometer, DSC, ATG, Turbiscan, Viscosimeter/densimeter, RapidOxy, StirOxy, Emulsification reactor

Keywords:
Homogeneous catalysis, fine chemistry, organometallic chemistry, polymerization, organic synthesis, oxidation, physical-chemistry, formulation, photochemistry, biomass, green chemistry,

Main fields of applications:
Fine chemistry, polymeric materials, pharmaceutics, flavors & fragrances, cosmetics, paints and varnishes, food, detergency, green solvents, surfactants, antioxidants, speciality chemicals

UNIT OF MATERIALS AND TRANSFORMATIONS UMR
CNRS 8207

http://umet.univ-lille1.fr/

Director : Prof. Alexandre Legris (alexandre.legris@univ-lille1.fr)

Université des Sciences et Technologies de Lille
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Department 1 : POLYMERS ENGINEERING

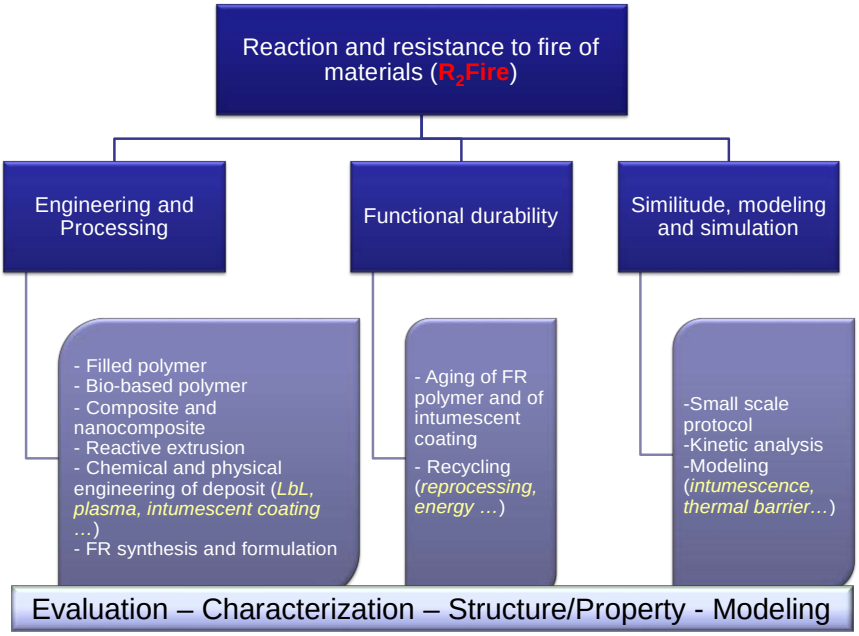
Head of Department: Prof. Serge Bourbigot
(serge.bourbigot@ensc-lille.fr) Phone: +33 (0) 320 43 48 88
Fax: +33 (0) 320 43 65 84
http://lspes.univ-ille1.fr/Perf/index.php?lang=en
Location of the team at ENSCL, building C7

Research Fields:

- **Reaction and Resistance to Fire of Materials 'R_2Fire'** (Contact : Prof. S. Bourbigot)

The main topics of the group R2Fire are resistance and reaction to fire of material. It works on the development of new halogen-free formulations that do not evolve toxic and corrosive smoke in the conditions of fire. Different approaches are considered: intumescence, ceramic-like formation and nanocomposites. R2Fire has expertise in:

- ✓ processing of thermoplastic and thermosets,
- ✓ formulation development,
- ✓ reaction and resistance to fire: fire testing and development of novel tests at the lab scale
- ✓ physico-chemistry of degradation of flame retarded materials including thermogravimetry, differential calorimetry, kinetic of degradation (modeling and simulation),
- ✓ rheology in complex media of polymeric materials,
- ✓ characterization of polymers and degraded materials using techniques such as solid state NMR, FTIR, Raman spectroscopy, XPS, ESR, X-ray diffraction, and optical and electronic microscopy, gas analysis of evolved gases from burning materials,
- ✓ modeling and numerical simulation (heat and mass transfer).



Equipment

- Processing
  - *Twin screw extruder (co-rotating) with outgassing and multi-feeding zones*
  - *Single screw extruder*
  - *Mixers (350 cc, 50cc) equipped with 'N_2 chamber'*
  - *Micro extruder equipped for making film and monofilament (Film, Micro melt spinning machine)*
  - *Melt Flow Index*
- Fire testing
  - *Limiting oxygen index*
  - *UL-94*
  - *Glow wire test*
  - *Mass loss calorimeter*
  - *Small furnace (designed to simulate ISO 834, UL1709 tests at the small scale)*
  - *Mini Steiner tunnel (designed to simulate ASTM E-84 test at the small scale)*
  - *Burner tests (designed to simulate ISO2635 and NexGen)*
- Thermal analyses
  - *DSC and MDSC (including k = f(T))*
  - *Very high heating rate TGA (up to 500°C/min) connected to FTIR*
  - *Simultaneous TGA/DSC at high temperature (1550°C)*
  - *Hot disk (heat conductivity up to 1000°C)*
  - *Laser Flash Analysis (thermal diffusivity up to 500°C)*
  - *High temperature rheometer*
- Evolved gas analysis
  - *TGA/FTIR*
  - *Pyrolyzer GC/MS*
  - *FTIR bench (quantitative analysis of gases connected to cone, furnace, fire bench …)*
- Aging
  - *Accelerated weathering by UV (controlled T and RH)*
  - *Ventilated oven (controlled T and RH)*
- Microscopies
  - *Optical and numerical microscopes*
  - *Electronic microprobe (EPMA)*
  - *SEM with EDX*

- *TEM*
- *AFM*

- Spectroscopy
  - *Liquid/solid state NMR (100, 300 (x2), 400 (x3), 800, 900 MHz)*
  - *XRD*
  - *XPS*
  - *ESR*
  - *FTIR/ATR*

- **Engineering of surface treatment**

  Contact : Prof. M. Traisnel : michel.traisnel@ensc-lille.fr

  - Biomaterials
  - Surface modification/Coating by chemical way (sol-gel + chemisorption of corrosion inhibitors)
  - Surface modification /Coating by physical way (cold plasma + flaming)
  - Adhesion

Equipment

- Surface treatment
  - *Cold plasma (radiofrequency and microwave) equipped with different chambers*
  - *Atmospheric plasma*
  - *Spraying machine*
  - *Coating machine*
  - *Padding machine*
  - *Contact angle meter*

- **Functional polymeric systems**

  Head : Prof. Bernard Martel : **Bernard.Martel@univ-lille1.fr**

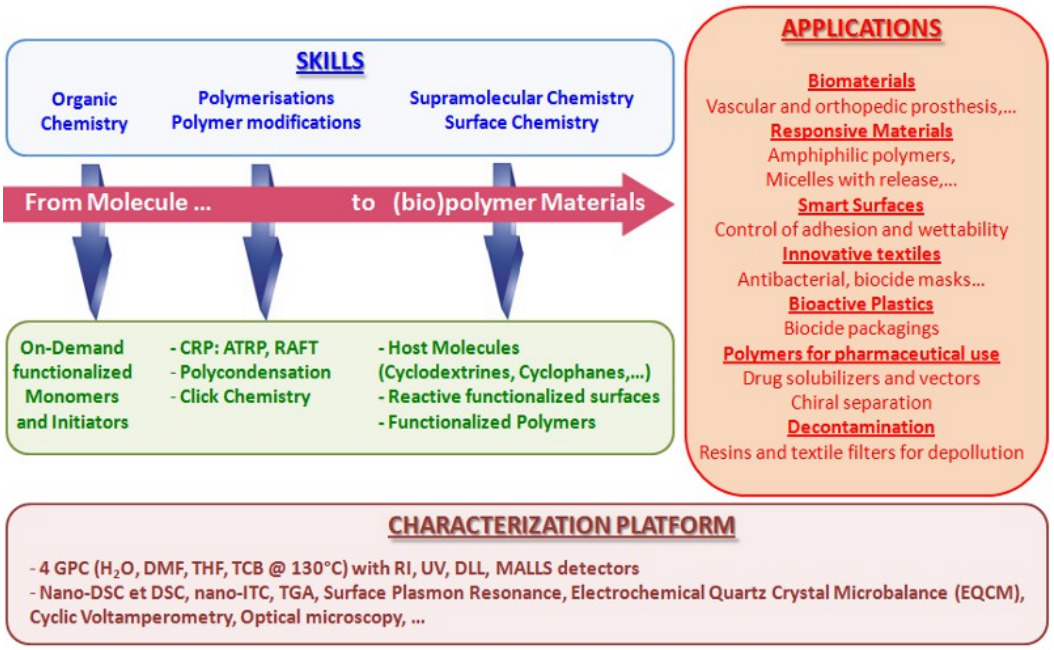
  Contact : Prof. Patrice Woisel : patrice.woisel@ensc-lille.fr

  and Dr. Frederic.cazaux@ensc-lille.fr

  For details : http://umet.univ-lille1.fr/Polymeres/index.php?lang=en

  ISP team of UMET at University of Lille 1 supervised by Pr Bernard Martel is specialist of polymer chemistry and is specialized in biopolymers and cyclodextrins (CD) based systems such as CDs polymers and (bio)materials modified with CDs. The first field of investigation concerns drug delivery systems in particular biomedical devices with antibacterial properties such as vascular prostheses and stents, hernia inguinal meshes, wound healings etc. A second field of investigation deals with filters and resins elaboration applied to environmental protection purposes such as industrial waste waters and sediments decontamination. The group also works on drug vectorization by the elaboration of CD based galenic excipients and antibacterial food packaging. Research activity in the domain of catalysis has been recently developed through a collaboration with UCCS-CASU where CD polymers have been advantageously combined with catalytic metallic nanoparticles applied to hydrogenation reaction of biosourced compounds. Electrospinning applied to biomaterials has been launched in the group in 2013, is being extended to other applications in other fields, such as supported catalysis.

Research within the research group focuses upon the design, synthesis and characterization of functional macromolecules and nanoparticles and their self-assemblies. Current themes include multi-stimuli responsive micelles/vesicles/surfaces/sensors and multi-functional materials including biomaterials, drug solubilizers and vectors, biocide packaging systems, and smart hydrogels.
Active projects :
Novel concept of antimicrobial packaging polymers)
-Synthesis and properties of well-defined polymers using Controlled Radical -polymerizations such as ATRP and RAFT.
-Supramolecular Chemistry or the design of multi-stimuli responsive polymeric materials
-Functional polymeric systems applied to biomaterials for the delivery of therapeutic agents
-Elaboration of smart surfaces for therapeutic applications
-Micro and nanoparticular systems for the sustained delivery of active molecules



- **Mechanics of complex macromolecular systems :**

  For details : http://umet.univ-lille1.fr/Polymeres/index.php?lang=en

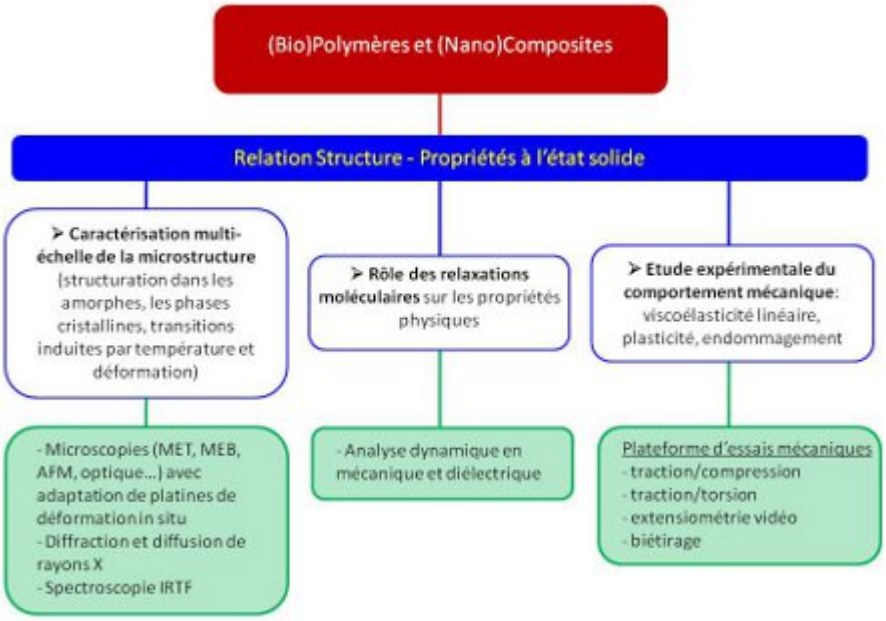
  Contact : Prof. Jean-marc.lefevre@univ-lille1.fr

  Active projects :

  -Biobased polymers (Prof. Jean-Marc Lefèvre)
    - Study of Polylactide (PLA), Polyamide11 (PA11) and clay-filled nanocomposites
    - Study of biopolymers from renewable resources (cellulose, starch, chitosan)

  -Composite systems (Prof. Jean-Marc Lefèvre)
  -Study of (nano)composites based on carbon nanotubes or clays (interfacial behavior, molecular dynamics...)
  -Biaxial drawing of hydrogen bonded polymers (Prof. Jean-Marc Lefèvre)
  -Deformation-induced structural evolution under uniaxial/biaxial stretching of mono- or multilayer polymer films
  -Electroactive polymers ((Prof. Jean-Marc Lefèvre)
  -Structural study and electro-mechanical properties

-Equal channel angular extrusion (ECAE) (Prof. Jean-Michel Gloaguen)
-Development of the process / Structural and morphological evolution upon simple shear
-Elementary plastic deformation mechanisms (Prof. Patrice Woisel)
-Plasticity of amorphous polymer systems: influence of macromolecular structure modification by « Click Chemistry »
-Novel concept of antimicrobial packaging polymers (Prof. Maryse Bacquet)



Departement 2 : PHYSICAL METALLURGY AND ENGINEERING MATERIALS

Head of Department : alexandre.legris@univ-lille1.fr
Address : Université des Sciences et Technologies de Lille
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Phone : + 33 3 20 43 49 75

The team comprises three research group:

- Modelling and simulation
- Microstructures
- Mechanical properties and effect of environment

Research Fields :
Elaboration of materials and surface treatments
Mechanical properties and environmental effects
Mechanical alloying and nanomaterials
Behaviour and damage mechanism of metallic
alloys Synthesis and mastering of microstructures
Electron microscopy
Modelling, calculation and simulations

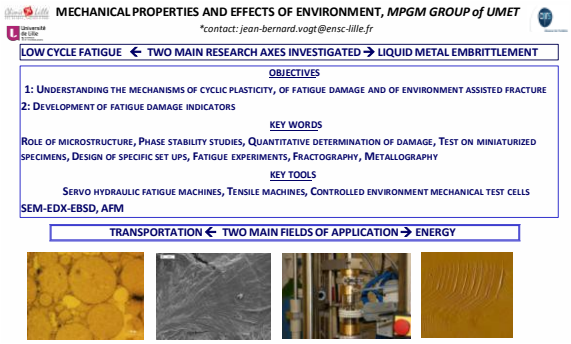
Scientific equipment :
X Ray diffractometer

Transmission and reflection Mössbauer Spectrometer
Scanning and transmission electron microscopes
Optical microscope and image collection system
Dilatometer

Electrochemical equipment
Micro- et macro-indentation
Tensile, fatigue and impact machines Nitriding facilities and galvanisation unit High energy mill, cold roller
Heat treatment furnaces Gold and carbon sputtering

Keys-words :
Mechanical tests and fracture analysis
Microscopies -metallography Mössbauer spectroscopy
Corrosion
Microstructure-galvanisation

Main fields of applications :
Metallurgy – Steel making
Nuclear energy Transportation industry Battery



Department 3 : MOLECULAR AND THERAPEUTICAL MATERIALS

For details : http://umet.univ-lille1.fr/Polymeres/index.php?lang=en

Head of department : alain.hedoux@univ-lille1.fr

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Bât. P5
Université Lille1
F-59655 Villeneuve d'Ascq
Tel: +33 (0)3 20 43 46 77

Our research activity concerns the **physical state of molecular materials** composed of small molecules and/or of biological molecules under various stresses: temperature, pressure, grinding, dehydration. The main goal is to analyse the situations of metastabilities, the glassy states and the phase transformations and out-of-equilibrium evolutions induced by these stresses. The investigated materials are also found in the pharmaceuticals and food domains.Our works have direct implication in the control of the formulation and the stability of these materials with direct consequences on their bioavailability.

- Physics of the glass transition
  Dynamical heterogeneities, nucleation and nanostructures, glassy crystals, polyAmorphism
  Contacts : F. Affouard, Laurent Carpentier, M. Descamps
- Driven molecular materials
  Transformations induced by grinding and dehydration
  Contacts : Jean-François Willart, Marc Descamps, Emeline Dudognon
- Protection of biological materials
  Mechanisms of stabilization of sugars, cold and thermal denaturation
  The activities are undertaken in the framework of the ANR PCV research project 2007-2011 BIOSTAB "Optimisation of the stability of biological materials for novel therapeutic strategies".
  Contacts : Alain Hédoux, Yannick Guinet, Frédéric Affouard

- Innovative multicomponent drug design for enhancing regional strategic advantages in pharmaceutical and biomedical applications (IMODE)
  Cross-border cooperation programme 2014-2020
  INTERREG "2 Mers Seas Zeeën"
  Contact : Frédéric Affouard

Department 4 : MINERAL PHYSICS

Head of Department : Prof. Patrick Cordier (patrick.cordier@univ-lille1.fr)
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Bât. C6
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For details : http://umet.univ-lille1.fr/Polymeres/index.php?lang=en

The *Mineral Physics* group studies the evolution of materials during the formation of the solar system and the dynamics of planetary bodies. The team applies concepts and methods from materials science and physical metallurgy to problems relevant for the origin and the evolution of planets.

Historically, the team studied microstructures in minerals using transmission electron microscopy (TEM). The research subject was then extended to experimental work, both using thermal processes and high pressure devices (diamond anvil cells, piston-cylinder, etc). The team also develops a strong

activity in numerical modeling using multi-scale methods, relying on a local computing cluster at University of Lille and national facilities (IDRIS).

Current projets

- Defects and plasticity: numerical models
  Contacts: Philippe Carrez, Patrick Cordier, Karine Gouriet
- Defects and plasticity: electron microscopy
  Contacts: Patrick Cordier, Alexandre Mussi
- Origin of materials in the solar system
  - Transmission electron microscopy
  - Laboratory analogues (alteration, thermal anhealing)

  Contacts: Corentin Le Guillou, Christophe Depecker, Damien Jacob, Hugues Leroux
- Deformation under high pressure: large scale facilities
  Contacts: Sébastien Merkel, Paul Raterron, Nadège Hilairet
- Polycrystal behavior: numerical models
  Contacts: Sébastien Merkel, Nadège Hilairet
- OH and atomic diffusion in minerals
  Contacts: Jannick Ingrin, Christophe Depecker