

MESOCRYSTALS
 CULTURAL HERITAGE
 DIMENSIONALITY
 CATALYSIS
 PROPERTIES
 SURFACES
 ENVIRONMENT
RESEARCH
 REACTIVITY
 EXTREME CONDITIONS
 TRANSPORT
 MATERIALS
 INTERFACES
 CONFINEMENT
 BIOMINERALIZATION



MATerials InterfaceS Surfaces Environment



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**Laboratoire de Chimie de la Matière
 Condensée de Paris – UMR CNRS 7574**

PERMANENT STAFF

68 people, 5 teams:

Materials and Biology (7) (Thibaud.Coradin@upmc.fr)
 Hybrid Materials and Nanomaterials (12) (clement.sanchez@upmc.fr)
 Sol-Gel Materials and NMR (11) (florence.babonneau@upmc.fr)
 Materials for Photonics (6) (bruno-viana@chimie-paristech.fr)
 Complex Inorganic Materials (8) (gilles.wallez@upmc.fr)
 Logistic team (24)

MOBILIZED COMPETENCES

- Chemical approaches of biomineralization processes and applications in biotechnological/biomedical devices
- Chemical routes for the bottom-up design of functional hybrid and inorganic nanomaterials with hierarchical ordering
- Development of specific NMR techniques for assessing the structure of materials originating from molecular building-blocks
- Approaches toward materials for bio-imaging, lasers and quantum information
- Creation and development of special glasses, ceramics and single crystals for energy applications and information storage through spin manipulation

MAIN FACILITIES

- Chemical synthesis (autoclaving, microwave heating,...)
- Bacterial and animal cell culture, histology, biochemical analyses
- Processing of materials (dip-coating, aerosols, flash sintering, supercritical drying)
- Electron microscopy (TEM, SEM, Cryo-TEM, Tomography)
- Structural characterization (X-ray diffraction, Small Angle X ray Scattering)
- Spectroscopy (IR, UV-vis, emission), EPR and NMR
- Characterization of surfaces and dispersions (ellipsoporosimetry, dynamic light scattering, zeta-meter)

PROJECTS WITHIN MATISSE FRAMEWORK

- Biomineralization in confined environments
- Bioremediation processes
- Green chemistry applied to biomimetic functional materials
- Mesocrystals
- Behavior of nanocomposites under extreme conditions
- Synthesis of novel nano-phases
- Design of hybrid nanostructured materials for energy harnessing and catalysis



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UPMC
 SORBONNE UNIVERSITÉS



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**Institut de Minéralogie et de Physique des
 Milieux Condensés – UMR CNRS 7590**

PERMANENT STAFF

Materials under extreme conditions (12)
 (Guillaume.Fiquet@upmc.fr)
 Advanced Materials and Nano-oxides (17)
 (Abhay.Shukla@upmc.fr)
 Geomicrobiology and Environmental Mineralogy (18)
 (Karim.Benzerara@impmc.upmc.fr)
 Glasses and Cultural Heritage (6)
 (Georges.Calas@upmc.fr)
 Quantum Theory for Materials (8)
 (Francesco.Mauri@upmc.fr)

MOBILIZED COMPETENCES

- Measurements of properties of Earth's materials and molecular solids at extreme pressure and temperature conditions
- Specific out-of-equilibrium synthesis methods for the design of novel materials
- Fossilization processes and the search for ancient traces of life in rocks; control of inorganic pollutant mobility by microorganisms in soils and rivers; role of minerals and microorganisms in the geological cycle of carbon.
- Structural properties of glasses and melts as well as speciation of minor elements in glasses and minerals.
- Prediction of the physical properties of real materials using first principle methods.

MAIN FACILITIES

- Experiments developed on synchrotron beamlines at SOLEIL: Deimos, Galaxies and Hermes
- Electron microscopy (TEM, SEM, FIB)
- Powder and single crystal X-ray diffraction
- Acoustic, optical and magnetic properties (PPMS 9T; Cryomagnet 7T/200mK)
- Microbiology laboratory
- Ab initio codes for the simulation of NMR, XANES, IR, Raman, EPR spectra, inelastic neutron and X-ray scattering.

PROJECTS WITHIN MATISSE FRAMEWORK

- Carbon cycle, origin and history of life, recent and ancient biomineralizations
- Molecular scale reactions at mineral-water interfaces, degradation and long term sequestration of pollutants
- Out-of-equilibrium synthesis of superconductors and ultra-hard materials.
- Exotic electronic and magnetic states in 2D materials and in nano-oxides.
- Cultural heritage and new pigment technologies
- Materials at extreme conditions, glass transition mechanisms



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Laboratoire de Réactivité de Surface
UMR CNRS 7197

PERMANENT STAFF

Catalysis: From Materials to Reactivity (27 permanent researchers)
catherine.louis@upmc.fr, pascale.massiani@upmc.fr
 Surface Reactivity in Biological Environments (10 permanent researchers)
claire-marie.pradier@upmc.fr, jean-francois.lambert@upmc.fr

MOBILIZED COMPETENCES

- Molecular approach of catalyst preparation,
- Oxide and metal nanoparticles, oxide surfaces, micro-mesoporous materials.
- Advanced characterization, In situ and Operando: Correlations between structure, chemical properties and activity, identification of active sites.
- Catalytic applications: pollution abatement of gas effluents
- Catalytic reactions with low environmental impact.
- Interaction of biomolecules with metal and oxide surfaces.
- Prebiotic mechanisms on oxide surfaces.
- Biocompatible and bio-resistant materials.
- Hybrid bio-inorganic materials for drug delivery and biosensors.

MAIN FACILITIES

- XAFS and IR on synchrotron beamlines at SOLEIL and ESRF
- Electron microscopy (TEM, SEM) and powder X-ray diffraction
- Vibrational spectroscopies : FTIR, RAMAN, SERS, ATR, IRRAS
- Liquid-state and solid-state NMR
- Atomic Force Microscopy (AFM), contact angle, QCM
- Surface analysis plate-form: Photoelectron Spectroscopy (XPS), Auger (AES),
- Photoluminescence spectroscopy, UV-visible spectroscopy
- Electron Paramagnetic Resonance (EPR), 4 and 77 K

PROJECTS WITHIN MATISSE FRAMEWORK

- Synthesis of metal or oxide nanoparticles on oxides or carbides
- Eco-compatible catalytic processes, use of renewable resources,
- Catalysis for depollution and environment; gas/solid and liquid/solid catalysis
- Adsorption in porous media
- Mutual structuring effects between nanoparticles and biomolecules, bioinspired synthesis strategies
- Origins of life
- Adsorption, self-assembling of biomolecules on surfaces, induced chirality
- Surface functionalisation for biosensors , biomaterials, drug delivery

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Institut des NanoSciences de Paris
UMR CNRS 7588

PERMANENT STAFF

Quantum Devices (8)
 (Dimitri.rodichev@insp.jussieu.fr)
 Confinement and transport in Optics and Acoustics (19)
 (Bernard.Perrin@insp.jussieu.fr)
 Structure, Dynamics and Reactions at Interfaces (27)
 (Yves.Borensztein@insp.jussieu.fr)
 Nanomaterials: Growth, Polarity and Strong Interactions (26)
 (Jacques.Jupille@insp.jussieu.fr)

MOBILIZED COMPETENCES

- Superconductivity in non-conventional or confined superconductors; superconductor-insulator transition in ultra-thin films
- Engineering of 1D or 2D phononic crystals and natural or synthetic 2D photonic crystals for new frontiers in acoustics and optics
- Elaboration and control of surfaces and interfaces of nanostructures for technological applications in catalysis, chemical sensors or nano-electronics.
- Design and simulation of oxide surfaces, interfaces, thin films and nanoparticles in ultra-high vacuum and humid environment

MAIN FACILITIES

- 3 MBE chambers dedicated to semiconductors, oxides and metals respectively
- Powder and single crystal X-ray diffraction
- 8 pump-probe femtosecond setups for acoustic, optic and magnetic properties
- 3 STM working in UHV (<10⁻¹⁰ mbar) at low (2.5K) and ultralow (0.3K) T in high magnetic fields (8T) coupled to in-situ elaboration/characterisation facility
- STM/STS working from UHV to atmospheric pressure
- 2 SQUID high-sensitivity cryogenic magnetometer
- Clean Room facility (170 m² + 80m², UV photolithography, MEB...)
- SAFIR: 2.5 MV Van de Graaff accelerator with 5 beamlines
- SIMPA : ECR ion source (Super Nanogan type, 14.5 GHz)
- Experiments developed on synchrotron beamlines at SOLEIL: Sextants, Sirius
- Ab initio codes for the simulation of structures, complex interfaces...

PROJECTS WITHIN MATISSE FRAMEWORK

- Confinement and transport of phonons and photons
- Electronic and magnetic properties of strongly confined nanostructures
- Toward a control of surfaces, films and coatings
- Molecular scale reactions at mineral-water interfaces
- Oxidation reactions on supported gold and gold-based bimetallic nanoparticles

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Institut des Sciences de la Terre de Paris
 UMR CNRS 7193

PERMANENT STAFF

Biomineralizations and sedimentary environments (10)
marc.de_rafelis@upmc.fr
 Lithosphere, deep processes (11)
evgenii.burov@upmc.fr
 Petro-geochemistry, volcanology (8)
albert.jambon@upmc.fr

MOBILIZED COMPETENCES

- Metamorphic petrology and thermodynamics of lithosphere and mantle materials
- Coupled thermomechanical and thermodynamic numerical modeling of small and large scale geological and geodynamic processes, non-linear rock rheology, interface processes
- Geochemistry of meteorites
- Properties of geomaterials at extreme P-T conditions
- Sedimentology, cyclostratigraphy, sismostratigraphy, analysis of brittle deformation and paleostresses, petrophysics and biomineralizations

MAIN FACILITIES

- Parallel computation facilities: a 70 core distributed memory cluster; a 48 core "thick node" shared memory cluster
- Finite-element codes for non-linear large-strain thermo-mechanical processes
- Magnetic susceptibility MFK-1A (Agico) and SM-20 (ASC Scientific)
- 2 isotope mass spectrometers C and O
- Absorption FOUR & FLAMME (GAAS-FAAS), Emission (ISP-AES) spectrometers
- X-ray diffractometer
- Electron microscopy (SEM)
- Electron microprobes

PROJECTS WITHIN MATISSE FRAMEWORK

- Subduction and subduction channel processes, water budget
- High and ultra-high pressure exhumation processes and rheology
- Properties of magmas at extreme conditions
- Study of meteorites and planetary differentiation
- Studying palaeoenvironmental signals using cathodoluminescence, chemical and stable-isotope analysis of fossils



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**Biogéochimie et écologie des milieux
 continentaux – UMR CNRS 7618**

PERMANENT STAFF

Organic and inorganic environmental geochemistry (11)
 (sylvie.derenne@upmc.fr)

MOBILIZED COMPETENCES

- Chemical structure of organic matter in natural environments (soils, rivers, sediments, meteorites)
- Dynamics of carbon, nitrogen and metalloid elements (Se) in continental systems
- Transfer of matter towards the hydrographic network
- Search for evidences of life and oxygenic photosynthesis in ancient rocks
- Organic cosmochemistry

MAIN FACILITIES

- Gas chromatography Mass spectrometry (GC-MS)
- Curie point pyrolysis GC-MS
- Isotopic ratio mass spectrometry (13C, 15N, 18O)
- Atomic absorption spectrometry (Flame AAS, Electrothermic AAS)
- Inductively coupled plasma mass spectrometry (ICP-MS)
- Organic chemistry laboratory, accelerated solvent extraction
- Gas and liquid chromatography (GC, HPLC)

PROJECTS WITHIN MATISSE FRAMEWORK

- Carbon cycle, dynamics and transfer of organic matter in continental systems
- Organic cosmochemistry : organic matter in meteorites
- Search for bio-signatures in ancient rocks

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**Laboratoire de Physique Théorique de la
 Matière Condensée – UMR 7600**

PERMANENT STAFF

Stochastic Dynamics of Living and Reactive Systems (10)
 (Olivier.Benichou@upmc.fr)
 Geomaterial and Glasses Modelling (6)
 (Bertrand.Guillot@upmc.fr)
 Quantum phase transition and disordered matter (9)
 (Remy.Mosseri@upmc.fr)

MOBILIZED COMPETENCES

- Random walks, first-passage times, diffusion limited reactions
- Multi-scale modeling of industrial materials
- Multi-scale modeling of biological macromolecules
- Modeling of magmatic liquids and volatile bearing melts
- Molecular dynamics simulations of covalent glasses
- Quantum phase transitions
- Disordered materials and frustration

MAIN FACILITIES

- Two clusters for high performance computations

PROJECTS WITHIN MATISSE FRAMEWORK

- Optimization of target search processes ; reactivity in confined media
- Hydration of plaster and gypsum crystallization
- Mechanical plasticity of macromolecular complexes
- Fate of CO₂ in the Earth's mantle
- Thermodynamic and structural properties of silicate and carbonate melts
- Geometrical frustration in confined disordered matter



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**Physicochimie des Electrolytes, Colloïdes,
 Sciences Analytiques – UMR CNRS 7195**

PERMANENT STAFF

Multiscale Modelling and Dynamics (14)
marie.jardat@upmc.fr

MOBILIZED COMPETENCES

- Measurements of dynamic properties of disperse species in solution or in charged porous media: from simple ions to large colloidal particles (scattering experiments: light, X-rays, neutron; conductimetry, tracer and NMR, ...)
- Prediction/interpretation of transport and electrokinetic properties of charged fluids in porous media at several scales (from atomic resolution to macroscopic analytic methods)
- 2D and 3D imaging of disordered porous media by micro and nano X rays synchrotron tomography. Mathematical morphology and connection with transport and reactive properties at different scales
- Prediction of molten salts properties from first-principle simulations
- Systematic and rigorous upscaling (coarse-graining): polarisable force fields from ab initio, averaged mesoscopic description from all atom simulations,...

MAIN FACILITIES

- Solution chemistry lab: densimetry, potentiometry, refractometry, high precision conductimetry, ...
- Radiotracer experiments
- Acoustic and electroacoustic experiments
- Light scattering and electrophoretic mobility measurements
- Forced Rayleigh scattering setup
- Magneto-optical relaxation setup
- Computing facilities: 3 clusters of 16 nodes each
- Codes: classical polarizable molecular dynamics, Monte Carlo simulations, Brownian dynamics accounting for electrostatic and hydrodynamic interactions, Lattice-Boltzmann Electrokinetics

PROJECTS WITHIN MATISSE FRAMEWORK

- Transport in porous media: provide a comprehensive understanding of the transport properties of complex fluids in porous media for environmental and/or technological applications using the dual approach of numerical simulations and experiments
- Multiscale modelling of the above-mentioned systems
- Modelling of materials at extreme conditions



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**Laboratoire Interfaces et Systèmes
 Electrochimiques – UPR15 CNRS**

PERMANENT STAFF

Equipe MIMLISE (Matériaux, Instrumentation, Modélisation du LISE)
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MOBILIZED COMPETENCES

- Development of innovative electrochemical techniques
- Corrosion, corrosion inhibition, protection against corrosion (monitoring, passive films, conducting polymers films)
- Surface functionalization: biosensors, conducting polymers
- Mineral water interfaces: biofilms, scale, corrosion
- Dissolution or crystallization
- Modeling (localized corrosion, constant phase element)
- Synthesis of innovative materials: carbon nitride thin films, nano-structured metallic oxides (tubes, columns...), hybrid oxide nanoparticles/conducting polymer materials, and modeling of their electrochemical behaviour

MAIN FACILITIES

- DC magnetron sputtering reactor for carbon nitride film deposition
- Magnetron sputtering /evaporation reactor for thin metallic layers
- Pneumatic spray pyrolysis set-up for Tin Dioxide thin film deposition
- Characterization techniques (SEM-FEG, EDX, EBSD, Raman, AFM/CS-AFM, DEMS, powder and thin film X-ray diffraction ...)
- Electrochemical impedance and noise spectroscopies
- Electrochemical quartz crystal microbalance
- Scanning electrochemical microscopy

PROJECTS WITHIN MATISSE FRAMEWORK

- Characterization of surface properties of advanced materials by innovative coupling techniques: EIS, quartz microbalance, noise, EC-AFM, SECM, Raman, contact angle, SEM-FEG, X-rays...
- Preparation of new materials for specific applications: carbon nitride thin films to build innovative p-n junctions, nano-structured metallic oxides for photovoltaic applications, ion-selective electrodes for pollution detection

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Pôle de Physico-chimie théorique
Laboratoire PASTEUR, ENS – UMR 8640

PERMANENT STAFF

Theoretical physical chemistry group
 Solvation and molecular interactions
 (Daniel.Borgis@ens.fr)
 Thermodynamics in confined media
 (Anne.Boutin@ens.fr)
 Reactivity and spectroscopy in solution and at interfaces
 (Rodolphe.Vuilleumier@ens.fr)

MOBILIZED COMPETENCES

- Chemical processes in condensed phases
- Methods for the prediction and analysis of vibrational spectroscopies at finite temperature
- Structural, dynamical and thermodynamics properties of liquids from ambient to high temperature-high pressure conditions
- Electronic properties in liquids and melts as well as speciation of transition metals, lanthanides and actinides
- Adsorption in porous materials, inorganic and metal-organic frameworks
- Classical molecular DFT for solvation, confined media and interfaces

MAIN FACILITIES

- Development of classical Molecular Dynamics and Monte Carlo codes for simulation of molecular systems, including polarizable force-fields
- Development of classical DFT codes for chemical applications
- First-principle molecular dynamics codes, CPMD and CP2K

PROJECTS WITHIN MATISSE FRAMEWORK

- Multiscale modeling
- Analytical models and molecular simulation of adsorption in porous materials
- Materials at extreme conditions, first-principle simulation of natural silicate and carbonatitic melts



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Laboratoire de Physique et d'Etude
 des Matériaux – UMR CNRS 8213

PERMANENT STAFF

Nanomaterials, nanostructures and nanophysics (8)
 (Benoit.Dubertret@upmc.fr)
 Strongly correlated and low dimensionality electronic systems (14)
 (Jerome.Lesueur@upmc.fr)
 Materials and instrumentation (5)
 (Daniele.Fournier@impmc.upmc.fr)

MOBILIZED COMPETENCES

- Designing nanomaterials and nanostructures (plasmonics, Josephson devices)
- Synthesis of quantum dots
- Investigation of new materials whose properties strongly depart from the usual Landau theory of metals (superconductors, strongly correlated systems)
- Measurement of electronic and magnetic properties of solids, including at very low temperature and very high magnetic field
- Original devices from super-resolution and thermoreflectance microscopes to near-field probes

MAIN FACILITIES

- NMR
- Electron microscopy (TEM, SEM)
- XRD
- Electron transport measurements at very low temperature (10 mK) and very high magnetic field (14 T)
- AFM and STM
- UV-vis-IR spectroscopy

PROJECTS WITHIN MATISSE FRAMEWORK

- Photovoltaic applications of nano quantum dots
- Surface functionalization of quantum dots for advanced cell and in vivo imaging
- Fundamental studies of semi-metals and topological insulators
- Role of phonons in multiferroic materials
- Transport properties of doped 2D-oxides
- Imaging evanescent and interfering thermal fields
- Imaging using low-field NMR
- Charge localization in insulators and semiconductors



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**Laboratoire de Minéralogie et
 Cosmochimie du Muséum – UMR CNRS 7202**

PERMANENT STAFF

Cosmochemistry (9)
 Matthieu Gounelle (gounelle@mnhn.fr)
 Environmental Mineralogy (6)
 François Farges (farges@mnhn.fr)
 Mineralogy-Petrography (7)
 Violaine Sautter (vsautter@mnhn.fr)

MOBILIZED COMPETENCES

- Geochemistry of extraterrestrial samples (meteorites, interplanetary particles, etc.).
- Formation of the solar system
- Experimental Cosmochemistry: mineral condensation from the gas phase, chemistry under UV irradiation, organic chemistry
- Expertise in isotope fractionation and in analytical determination by SIMS of isotopic compositions (H, Li, B, C, N, O, Si) in natural samples.
- BioMineralisation (climatic reconstruction via corals chemistry) & Environmental Mineralogy (microorganisms-mineral relations, industrial materials, toxic environments,)
- Mantle rocks (Earth and Mars), Nanophases in rocks
- Precambrian paleontology – chemical fossils of microorganisms

MAIN FACILITIES

- At the Museum: NanoSims (High spatial resolution chemical and isotope mapping) - Sims 3f (D/H)
- Expertise (external facilities) in spectroscopy applied to natural materials: Synchrotron, Electron microscopy (TEM, SEM, FIB), X-ray diffraction
- Meteorite collection at the Museum
- Mineral collections

PROJECTS WITHIN MATISSE FRAMEWORK

- Experimental Cosmochemistry: gas/mineral transition
- Tracing the environmental conditions recorded in minerals and biominerals by chemistry and isotopes
- Patrimonial mineralogy (historical gems in the MNHN collections)
- Materials at extreme conditions: observations of the first natural minerals formed in the solar system

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**Laboratoire de Géologie de l'École
 normale supérieure – UMR CNRS 8538**

PERMANENT STAFF

Fluid/rock interactions: coupling between deformation and reactivity (3)
 (alexandre.schubnel@ens.fr)
 Environmental Mineralogy, soils, organic matter (2)
 (pierre.barre@ens.fr)
 Materials under extreme conditions (3)
 (jerome.fortin@ens.fr)
 Mineral stability and reactivity (2)
 (christian.chopin@ens.fr)

MOBILIZED COMPETENCES

- Measurements of properties of Earth's and synthetic (e.g. glass) materials under pressure, stress and temperature conditions.
- Fluid/rock interactions: coupling between deformation and reactivity.
- Reactivity and microstructures of natural and anthropogenic carbons.
- Minerals/organic matter interactions, coupling between soil mineralogy and aggregates formation and dynamics, role of clay mineralogy for ecosystem functioning.
- Extraterrestrial carbons.
- Silicate crystal-chemistry, clay mineralogy, high-pressure mineralogy.
- Hydrothermal synthesis and phase-equilibrium studies.
- Transport, mechanics of reservoir rocks ; CO₂ storage ; nuclear waste disposal.

MAIN FACILITIES

- Rock-deformation experiments under controlled conditions of pressure, strain, temperature and fluid composition.
- Acoustic monitoring of rock deformation under controlled pressure, temperature and fluid conditions.
- Cold-seal autoclaves for hydrothermal studies (100-700°C, 0.1-2 kbar), including an a-magnetic one. Two autoclaves with stirring and fluid tapping at high pressure and temperature conditions (to 500°C, 500 bars).
- Electron microscopy (FEG- SEM)
- Powder X-ray diffraction, Raman micro-spectroscopy
- High-resolution cryogenic magnetometer

PROJECTS WITHIN MATISSE FRAMEWORK

- Effect of phase transitions on the hydro-mechanical properties of materials deforming under high pressure and temperature conditions.
- Link of seismic activity with fluid production and circulation at depth.
- Role of mineral surfaces for organic-matter dynamics in soils.
- Reactivity and microstructures of natural and anthropogenic carbons.
- Mechanical behaviour of glass under controlled fluid conditions.
- Underground storage, reservoir rocks, transport.

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PERMANENT STAFF

Interfaces, transport, reactivity (6)
 (Eric.Kohler@ifpen.fr)
 Multi-scale modelling (3)
 (Hervé.Toulhoat@ifpen.fr)
 (Benoit.Noettinger@ifpen.fr)

MOBILIZED COMPETENCES

- Identification, understanding and prediction of reactions that transform rocks during burial or geological storage activities (mainly acid gases like CO₂)
- Density Functional Theory (DFT) in order to access chemical and physical properties of minerals and their interfaces
- Development of characterization techniques
- Creation of thermodynamics and kinetics databases
- Development of predictive numerical simulation programs taking into account the reactive transport at different scales of time and space.

MAIN FACILITIES

- Electron microscopy (TEM, SEM),
- Powder X-ray diffraction,
- Line of 6 hydrothermal cold-seal vessels (to 500°C and 0.5 GPa),
- 8 autoclave with fluid sampling under hydrothermal conditions,
- Micro CT X ray tomography,
- Atomic absorption spectrometry,
- Petrographic Microscopes.
- Multi-nodes cluster for High Performance Parallel Computing
- Computational chemistry software

PROJECTS WITHIN MATISSE FRAMEWORK

- Mineralogical and morphological characterizations of reservoir and cap-rocks, thermodynamic analysis of the chemical transformations
- Experimental evaluation of long term behavior of cap-rock, reservoir and cement-based materials during CO₂ storage or IOR operations
- Multi-scale transport modeling from atomic and molecular scales (molecular dynamics) to the scale of several pores (Pore Network Modeling, Random Walk) and upscaling of pore scale physics to large scale models.

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**Centre de Recherche sur la Conservation
 des Collections – USR CNRS 3224**

PERMANENT STAFF

Vision and appearance
 (vienot@mnhn.fr)
 Graphic and photographic records
 (lavedrin@mnhn.fr)
 Inks and colourant
 (rouchon@mnhn.fr)
 Leather and parchment
 (lrobinet@mnhn.fr)

MOBILIZED COMPETENCES

- Assessment of surface attributes (color, texture and gloss) and lighting issues.
- Impact of indoor climate on cultural artifact (organic materials, fossils...).
- Development of conservation treatments and methodologies for preservation of cultural heritage: remediation and mitigation.
- Physical and chemical characterization of artifacts and degradation processes.
- Implementation of sustainable strategies for museums and archives.

MAIN FACILITIES

- Access to experiments on synchrotron beamlines at SOLEIL (Ipanema)
- Climatic test chambers
- Light ageing and pollution test chambers
- Dynamic vapor sorption
- CE/MS, GC/MS
- Microbiology laboratory
- μ FTIR, μ Raman, multispectral analysis

PROJECTS WITHIN MATISSE FRAMEWORK

- Characterization of colourants and assessment of degradation processes
- Predicting models for cultural artifact decays.
- Macro and micro imaging luminescence spectroscopy in cultural artifacts.
- Impact of lighting on cultural artifact decays and appearance
- Sorption desorption of water in porous organic material and impact on durability

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Laboratoire de recherche des monuments historiques

PERMANENT STAFF

Conservation of stone (3)
 (Veronique.verges-belmin@culture.gouv.fr)
 Conservation of stained glass (3)
 (Claudine.loisel@culture.gouv.fr)
 Conservation of metal and concrete (4)
 (Annick.texier@culture.gouv.fr)
 (Elisabeth.marie-victoire@culture.gouv.fr)
 Microbiology (3)
 (Genevieve.orial@culture.gouv.fr)

MOBILIZED COMPETENCES

- Identification, physical and chemical properties and provenance of the materials of cultural heritage (stone, glass, metals, cement and concrete, pigments).
- Deterioration mechanisms of the materials (stone petrophysical properties, transformation of surfaces, such as epigeny, discolouration, soiling and black crusts formation on stones, leaching and corrosion of mediaeval glasses, corrosion of metals, chromatic alteration of pigments)
- Impact of microbiological growth on ancient materials, biodeterioration, formation of biofilms.
- Evaluation of the impact of restoration methods and products on the conservation of ancient materials (cleaning, consolidation, protection against environment). Development and assessment of new methods of conservation.

MAIN FACILITIES

- Optical microscopy and scanning electron microscopy (SEM);
- X-ray fluorescence (XRF), infra-red spectrometry (FTIR), chromatography (HPLC, GC-MS, and Ion chromatography), SEM-EDS, X-rays diffraction (XRD), Laser-induced breakdown spectroscopy (LIBS);
- Mechanical, optical and petrophysical measurements (dynamometer, colorimeters, Hg intrusion porosimetry, capillarity measurements,);
- Artificial weathering of materials and chemicals (climatic chambers);
- Microbiological laboratory ;
- In situ diagnosis methods: ultrasonic velocity measurements, rebars location, potential and Rp measurements; portable LIBS system)

PROJECTS WITHIN MATISSE FRAMEWORK

- Alteration of surfaces (dissolution-crystallization in decorated caves, stone soiling, surface decay of lead and lead alloys, concrete-steel interface in reinforced concrete)
- Historical glasses: from their history and elaboration techniques to their conservation (composition, colouration, provenances)
- Biodeterioration and bioremediation of materials of cultural heritage

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Centre de Recherche et de Restauration
des Musées de France

PERMANENT STAFF

Research on cultural heritage (10)
(marie.lavandier@culture.gouv.fr)

MOBILIZED COMPETENCES

- Physico-chemical and structural identification of the main materials encountered in the field of cultural heritage objects
- Studies of the origins and manufacturing processes or artistic techniques of objects or paintings
- Studies of the alteration and degradation processes of cultural heritage materials for the development of new coherent conservation strategies.
- Development of new restoration methods (cleaning, consolidation, protection techniques)
- Development of new characterization techniques. (Non-invasive and portable methods, dating methods)

MAIN FACILITIES

- Optical microscopy
- Electron microscopy (SEM)
- Radiography
- IR reflectometry
- Ion beam analysis (AGLAE)
- Microfluorescence X, ICP, thermoluminescence
- FT-IR, chromatography,
- Accelerator mass spectrometry.

PROJECTS WITHIN MATISSE FRAMEWORK

- Ancient materials preservation and restoration issues
- Understanding the manufacturing processes of selected cultural heritage artifacts (paintings, bronzes)
- Ageing and alteration processes as a function of use, burial, conservation
- Physics and chemistry of cultural heritage artifacts

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Centre André Chastel – UMR CNRS 8150
(CNRS – Université de Paris Sorbonne – MCC)

PERMANENT STAFF

Research on Stained Glass (5)
 (Michel.Herold@paris-sorbonne.fr)

MOBILIZED COMPETENCES

MAIN FACILITIES

PROJECTS WITHIN MATISSE FRAMEWORK

- Changes in the palette of glass used by the stained glass makers from the Middle Ages to our days
- Techniques of fabrication of this material
- Characterization of the samples and verification of the observations made about the works
- Choice of samples analyzed by the LRMH and the IMPMC

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PARTNERS and declared interest

ArcelorMittal

Wetting processes and behaviour of steels and Zn-based coatings in various environments

Saint Gobain Recherche

Glass elaboration, thin films, wetting and adhesion processes, mechanism of ageing of building materials

SAGEM

Surface dielectric properties of glasses, semi-conductors or quartz for laser and optronic instruments, getters for chimisorption

ESSILOR

New coatings, multifunctional optical layers for advanced optical elements

EADS

Multifunctional coatings, surface protection, innovative synthesis routes for new eco-compatible materials

Air-Liquide

Surface Chemistry, surface passivation, interface and transport phenomena

LAFARGE-Ciments

Alteration of building materials, wheathering of concrete and masonry surfaces, coloration, visual aspects of concrete and cements, physics and chemistry of melts and glasses

LVMH

Research in coloration, pigments and chemistry of complex systems

IFP-Energies nouvelles

Renewable energies and durable resources, modelling of clay stability for CO₂ storage, enhanced hydrocarbon recovery

ANDRA

Structure, reactivity and durability of natural or synthetic material for storage; need for analytical and modelling at various scales

CEA

Advanced materials, durability of nuclear glasses, irradiation effects, transport of fluid and matter for nuclear waste storage

MESOCRYSTALS
 CULTURAL HERITAGE
 DIMENSIONALITY
 CATALYSIS
 PROPERTIES
 SURFACES
 ENVIRONMENT
RESEARCH
 REACTIVITY
 EXTREME CONDITIONS

TRANSPORT
 CONFINEMENT
MATERIALS
 INTERFACES
 BIOMINERALIZATION

MATerials Interfaces Surfaces Environment

