



CARNOT INSTITUTE i2C

SUBLIMATE CHEMISTRY TO ENHANCE YOUR FUTURE



<https://carnot-i2c.fr/>



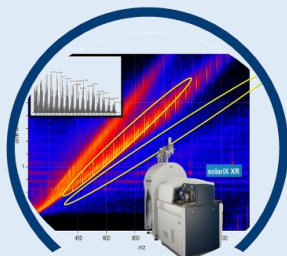
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Area of activity and R&D proposal

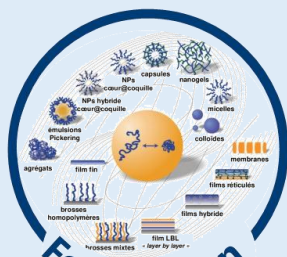
Expertises



Synthesis



Analysis



Formulation
Polymers

Chemistry for Health



Cosmetics

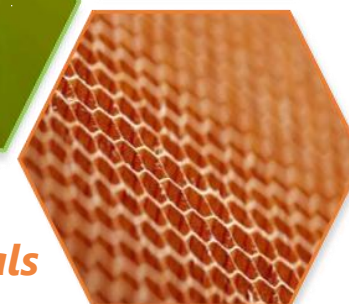


Chemistry for Sustainable Industry

*Sustainable
Development*



*Specialty
Chemistry*



*Materials
Polymers*



<https://carnot-i2c.fr/secteurs-dactivite/>



Chemistry for Health



Drug Discovery & Process

- ⚙ Chemical libraries exploitation → *in silico* and *in vitro* digging
- ⚙ Chemoinformatics → *in silico* screening and data mining
- ⚙ Design of active ingredients for therapeutic/diagnostic purposes
- ⚙ Design of bioactive molecules (enzyme inhibitors, RCPG ligands, APIs, ...)
- ⚙ Therapeutic repositioning
- ⚙ *In vitro* evaluation and objectivization of protein-protein interactions

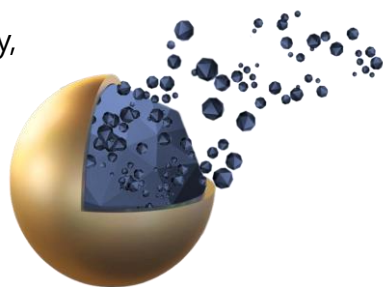


Biomedicines

- ⚙ Recombinant protein synthesis, site-specific modification
- ⚙ Biomedicine production systems (mAbs)
- ⚙ Chemical and biocompatible bioconjugation tools for chemobiology
- ⚙ Biotesting and fine analysis of post-translational modifications
- ⚙ Biomarker identification

Galenics & Vectorization

- ⚙ Controlled crystallization, polymorphism
- ⚙ Evaluation of physico-chemical properties (solubility, permeability, stability in biomimetic media)
- ⚙ ADME-toxicology prediction
- ⚙ Improved solubility and biodistribution
- ⚙ Innovative galenic formulations
- ⚙ Biomaterials (hydrogels, tissue repair, ...), 3D environment



Medical Imaging & Devices

- ⚙ Fluorescent and MRI probes, fluorophores
- ⚙ Radiotracers (PET, SPECT)
- ⚙ Radiolabeling (^{11}C , ^{18}F , ^{68}Ga , $^{99\text{m}}\text{Tc}$, ^{125}I , ^{123}I , ^{131}I) for treatment monitoring / efficacy, preclinical evaluation
- ⚙ Molecular tools for chemobiology and imaging
- ⚙ Bioanalyte detection tools, enzyme-linked immunodiagnostics





Cosmetic

Raw Materials

- ⚙️ Extraction and purification of functional molecule
- ⚙️ Development of innovative ingredient synthesis methods
- ⚙️ Multi-scale physico-chemical characterization, rheology, role of ingredients
- ⚙️ Biopolymers, natural alternatives to synthetic ingredients



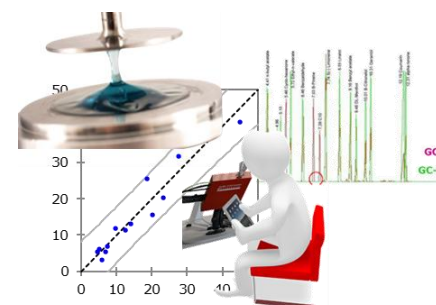
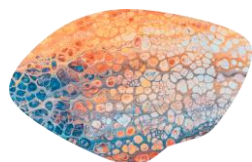
Formulations & Processes

- ⚙️ Formulation of classic and innovative matrices
- ⚙️ Skincare, pickering
- ⚙️ Encapsulation
- ⚙️ Continuous processes, new solid forms, pre-pilot



Innovative Materials Design

- ⚙️ Development of innovative materials for primary packaging
- ⚙️ Non-adhesive coatings, properties (roughness, wettability, ...)
- ⚙️ Tissue engineering: skin model surfaces



Analysis, Characterization & Prediction

- ⚙️ Physico-chemical characterization (raw materials, final products), rheology
- ⚙️ Sensory analysis (odor, color, texture, taste ...)
- ⚙️ Texture properties prediction tools
- ⚙️ Ingredient/formulation correlation

Safety & Innocuity

- ⚙️ Identification and quantification of undesirable substances (allergens, preservatives, MOAH/MOSH)
- ⚙️ Product/skin interaction, cell imaging, penetration visualization
- ⚙️ Product-environment interactions
- ⚙️ Deodorization, remediation strategy
- ⚙️ Deformulation





Sustainable development

Analysis of Environnemental Impacts

Agro- / Phyto-applications

Eco-friendly processes

Remediation & Recycling



Polymer Materials

Formulation & Processes

Valorization & Biopolymers

Membranes & Coatings

Physico-Chemical Characterization



Specialty chemistry

Organic Synthesis & Methodologies

Technologies & Processes

Crystallization & Solid-state forms

Advanced Analysis & Characterization



Sustainable Development



Environmental Impact Analysis

- ✿ Characterization of complex matrices, targeted/non-targeted analysis (petroleum fractions, polymers, plants)
- ✿ Environmental 2D-mapping and miniaturization
- ✿ Ultra-trace determination, deformation
- ✿ Fumes, gases and odors analysis
- ✿ Deodorization



Depollution & Recycling

- ✿ Electrokinetic remediation, phytoremediation, bioremediation
- ✿ Bio-based filters
- ✿ Recycling (controlled depolymerization, repolymerization)
- ✿ Chemical recovery of CO₂

Agro- / Phyto-applications

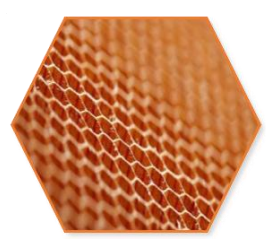
- ✿ Extraction and identification of molecules of interest
- ✿ Screening of bioactive molecules (biostimulant, biocide, biocontrol, elicitor)
- ✿ Stimulation of plant defense mechanisms
- ✿ Controlled release, encapsulation
- ✿ Metabolomics, lipidomics, plantomics



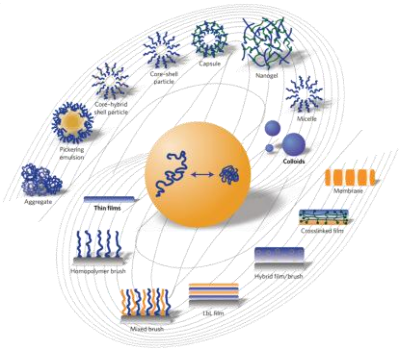
Eco-compatible Processes

- ✿ Flow processes (photochemistry, electrochemistry, catalysis, microfluidics, etc.), pre-pilot
- ✿ Continuous crystallization
- ✿ Line spray drying
- ✿ Intensification (productivity, selectivity, by-products)
- ✿ Use of bio-based monomers, photopolymerization





Polymer Materials



Formulation & Processes

- Adaptive polymers, hydrogels, colloidal systems
- Controlled encapsulation and vectorization
- Micro-compounding
- Nanocomposites for performance optimization
- Bio-based monomers (NIPU, polycarbonates), photopolymerization



Biopolymers

- Extraction, purification and characterization of bioresources
- Selective modification, functionalization and shaping (polysaccharides, etc.)
- Chemical functionalization of bio-based polymers
- Valorization of bioresources and co-products

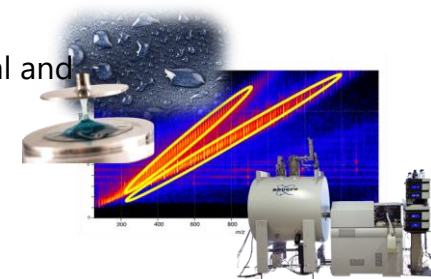
Membranes & Coatings

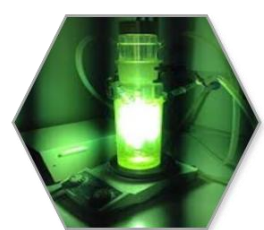
- Selective permeation, barrier properties (water, air, gases, solvents, ...)
- Surface functionalization (antifouling, antifogging, antiadhesive, antibacterial)
- Membranes and electrolytes for electrical energy



Physico-Chemical Characterization

- Measurement of rheological, mechanical, thermal and surface properties
- Process/structure/property relationships
- Deformation
- Deodorization

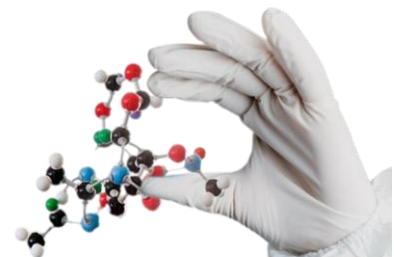




Specialty Chemistry

Organic Synthesis & Methodologies

- ✿ Various aromatic, aliphatic and Csp³-rich heterocycles
- ✿ Biomolecules (glycochemistry, peptide, nucleoside), molecular probes for bioimaging
- ✿ Non-usual fluorinated building blocks
- ✿ Organometallic complexes, dedicated ligands (N, P, carbene)
- ✿ Bio-based monomers



Crystallization & Solid Forms

- ✿ Preferential and/or continuous crystallization, chirality
- ✿ Polymorphism studies, structural purity of materials
- ✿ Determination of phase diagrams
- ✿ Crystal structure resolution
- ✿ Preparation of monocrystals, study of macroscopic defect formation mechanisms



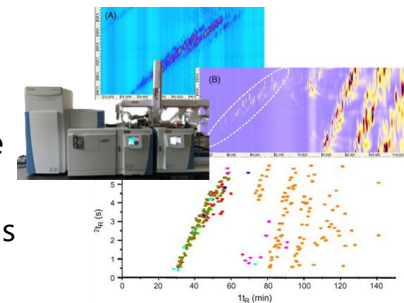
Technologies & Processes

- ✿ Technologies for synthesis (photochemistry, microfluidics, electrochemistry, alternative media)
- ✿ Intensification (productivity, selectivity, by-products)
- ✿ Catalysis (metallic, organic, photo-redox, C-H activation)
- ✿ Chirality (asymmetric synthesis, chromatographic separation, crystallization)
- ✿ Chemical and biocompatible bonding (click chemistry, bioconjugation and bioorthogonal)



Advanced Analysis & Characterization

- ✿ Raw materials/intermediates/finished products
- ✿ Structural analysis, molecular modeling, molecular interactions
- ✿ Analytical development (quantitative analysis, ultra-trace determination)
- ✿ Miniaturization of separative systems and on-line analysis
- ✿ Multidimensional analysis (LC and GC-MS, GC 2D, IMS-MS) of complex matrices
- ✿ Molecular mapping of petroleum products, polymers (FTICR), deformation





Carnot i2C – Chemistry for Sustainable Industry

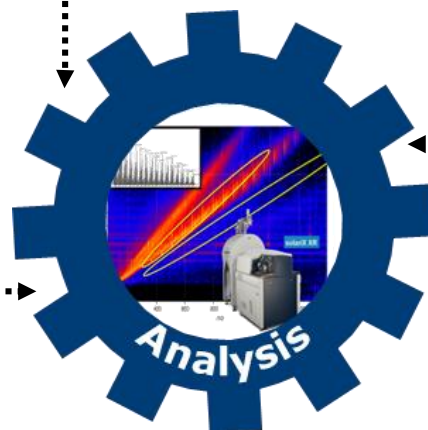
Analysis for a Sustainable Industry

Matrices

- Air, Gas, Fumes
- Water, Effluents
- Soil, Sludge
- Plants
- Waste, Co-products
- Materials, Polymers
- Petroleum, Tar
- Bio-oils, Bio-fuels

Properties

- Mechanisms Understanding
- Environmental Impact
- Aging, Stability
- Sensory (*Odor, Color, Texture / Rheology, Taste*)
- Barrier properties (*Water, Gases, Solvents*)



Methods

- Deformulation
- Characterization
- Pollutants, Traces, Ultra-traces
- Degradation products
- 2D-mapping
- Molecular networks
- Omics
- Quality
- VOCs, Odors
- Targeted, Non-targeted

50 M€ of equipment

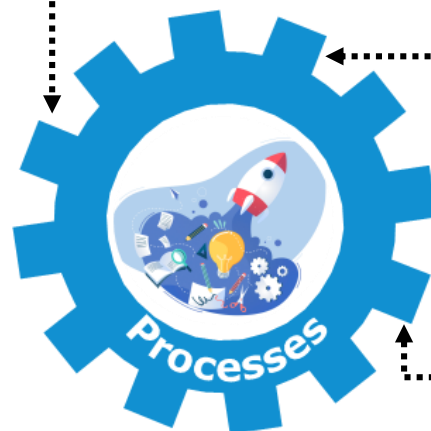


Carnot i2C – Chemistry for Sustainable Industry

Processes – Applications – Methods

Eco-responsible Chemistry

- Organic Synthesis
- Flow Chemistry
- Photochemistry
- Electrochemistry
- Catalysis
- Polymerization
- Crystallization
- Atomization
- Miniaturization
- Photo-polymerization



Barrier Properties

- Selective Permeation
 - Gases (CO_2 , He, H_2 , O_2)
 - Water
 - Solvents
- Surface Functionalization
- Membranes for Batteries

Activity Validation

- Biocides
- Biostimulants
- Biocontrols
- Elicitors
- Antifouling
- Antioxidant
- Antibacterial



Carnot i2C – Chemistry for Sustainable Industry

Valorization – Recycling – Depollution

Valorization

- Biomolecules Extraction
- Purification
- Bio-based Materials
- Bioactive Molecule Screening
- Formulation



Depollution

- Functionalized nanoparticles
- Membranes
- Bio-based filters
- Bioremediation
- Quality control

Recycling

- Chemical Depolymerization
- Biopolymer Functionalization
- Biomaterials Insertion



Carnot i2C – Innovation Chimie Carnot

How collaboration works



Certified quality approach

ISO 9001 : 2015

*Management and monitoring
of research partnerships*

One-stop shop

- *Supports the company*
- *Liaison with scientists*
- *Administrative follow-up*

Personalized partnership

- *Consulting*
- *Research services*
- *Collaboration contracts*
- *Technology transfers*
- *Common laboratories*
- *Industrial chairs*
- *Training*

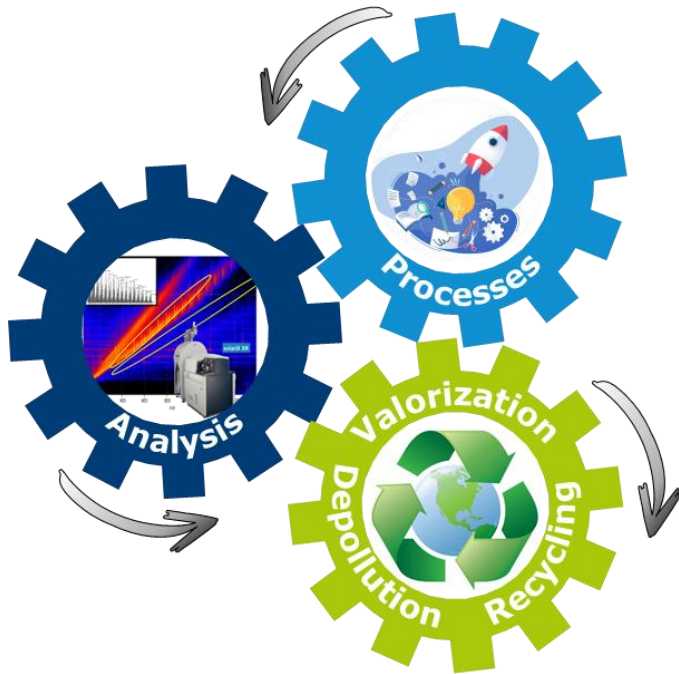
Eligible contracts to

- *French research tax credit (CIR)*
- *Collaborative research tax credit (CICo)*



**500
Experts**

A Support to Bioeconomy



Quality Management
Certified ISO 9001 : 2015



One-Stop Shop



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Contracts eligible to



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