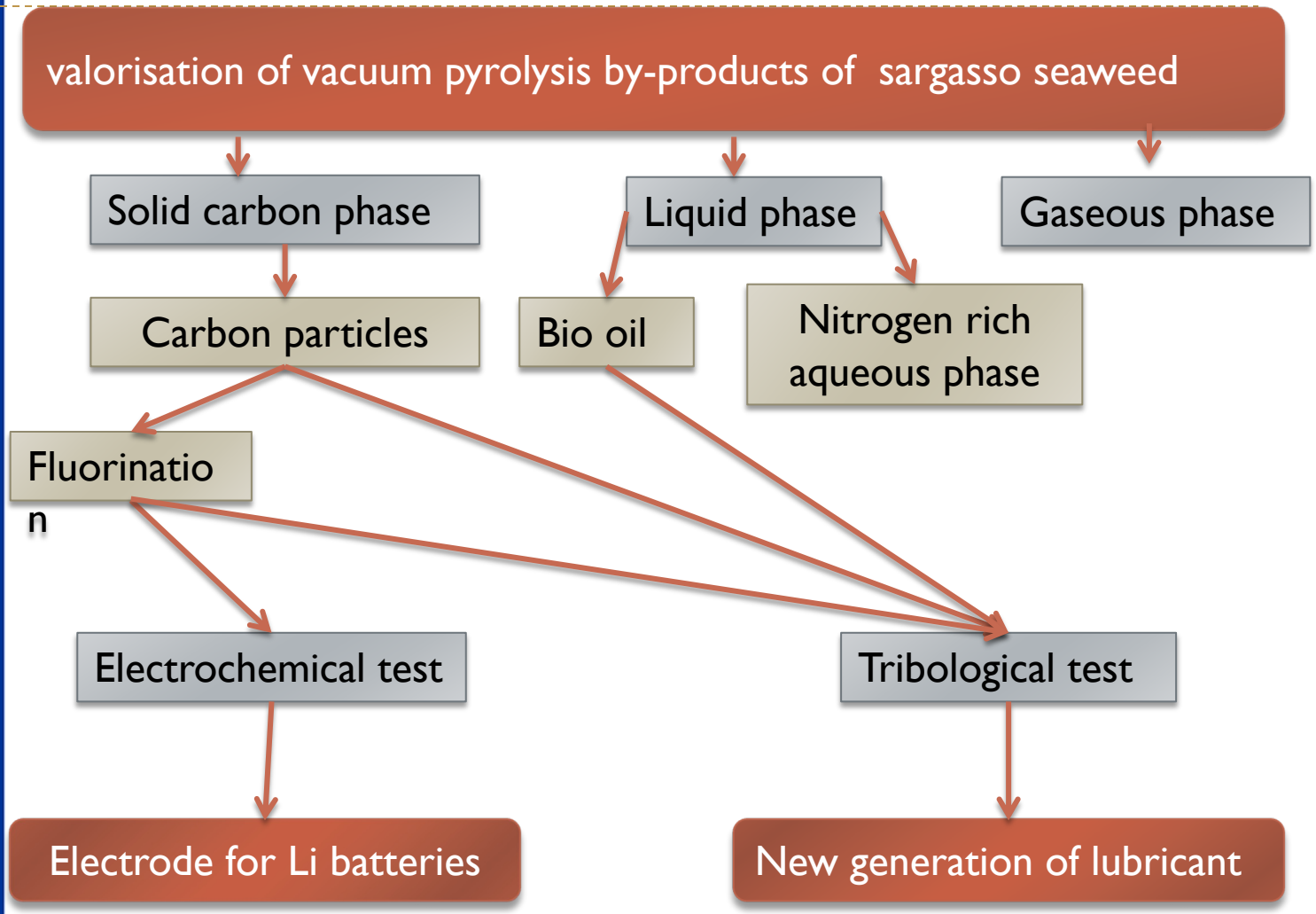
SarTrib

Thierry CESAIRE, GTSI

Plan

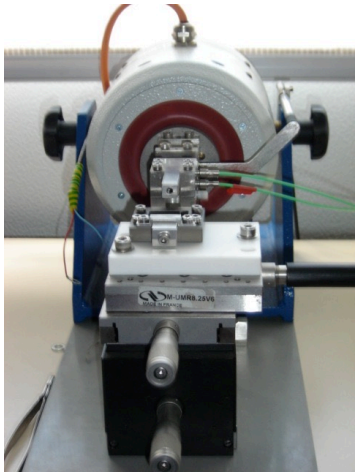
- The consortium
- Aims
- Management of the project
- Research questions addressed
- Results expected
- Added value/Dissemination/perspective for development

AIMS of SarTrib



The consortium : GTSI

Director Pr Laurence ROMANA

Tribology	Nano-mechanics	Physico-chemical Characterization
Friction reduction mechanisms and anti-wear	Multi-scale mechanical approach	New lubrication strategy
Carbon friction reducers derived from local biomass		
Carbon nano additives		

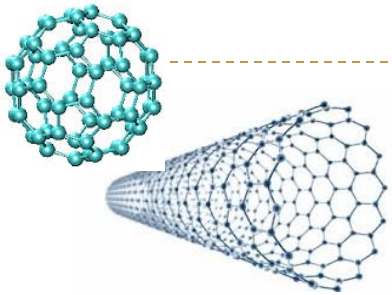
Raman IR Spectroscopies, TEM SEM X RD, X ray Fluorescence

C3MAG

Home build devices

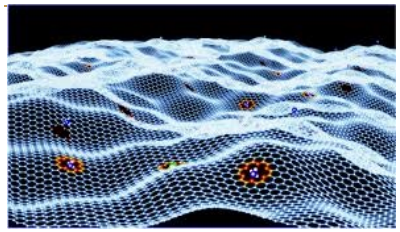
The consortium : : ICCF

Institut de Chimie de Clermont-Ferrand



Fluoridation and fluorinated matérials

Pr. Marc **DUBOIS**



Fluorinated materials for energy

- Hybrid nanocarbon or nanocarbon / nano-oxide materials as filters or materials sensitive to pollution gases.
- Carbide-derived carbons obtained by fluorination for use in supercapacitors
- Fluorides and oxyfluorides of transition metals as electrode materials for secondary batteries
- (Nano) fluorinated carbons as electrode for primary batteries

Surface engineering

- Surface treatment of polymers to obtain one or more properties (hydrophobicity, CO2, O2 and water gas barrier, antibacterial, ...)
- Incorporation of fluorinated nanocarbons in polymers
- Fluoridation of graphene, nanotubes, nanofibers and carbon nanodiscs
- Fluoridation of carbons and nanocarbons for tribology

The consortium : LCA

UMR 1010 INRA/INP-ENSIACET

LCA LABORATOIRE DE CHIMIE AGRO-INDUSTRIELLE

Director DR Zephirin MOULOUNGUI

Fractionation	Chemical reactivity	Analysis

Biomass

- Agriculture
- Agro-industry
- Forest
- Food waste
- Microalgae
- Algae

Bio products

- Agromaterials
- Solvents
- Pigments
- Surfactants
- Adhesives
- Aromas
- Additives
- Lubricants

The consortium : CREDDI-LEAD

CREDDI
Center for Research in Economics and Law on Island Development
- Laboratory of Economics Applied to Development
Director : Pr. Jean Gabriel MONTAUBAN

Development of models applied to the outermost regions

Preparation of various financing plan contracts,

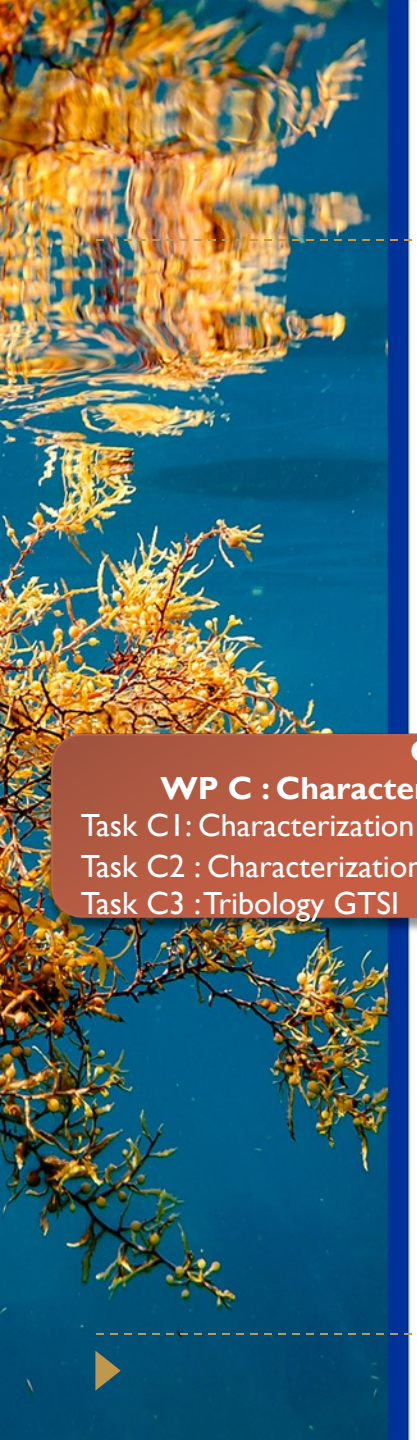
Structural Funds,

Surveys and econometric modelling

Economic project

Impact analysis

Management of the project



GTSI
WP A : Collection and project monitoring
Task A1: Project coordination GTSI
Task A2 Collection, subcontractor SARA

GTSI
WP B : Pyrolysis
Task A1: Characterization of biomass before pyrolisis GTSI and LCA
Task A2 : Pyrolysis, subcontractor Pyrovac

GTSI
WP C : Characterization and Tribology
Task C1: Characterization of pyrolysed liquid phase LCA
Task C2 : Characterization of pyrolysed solid phase GTSI
Task C3 : Tribology GTSI

Fluorinated particles

ICCF
WP D : Fluorination and electrochemistry
Task D1: Fluorination of porous carbons
Task D2 : Characterization of fluorinated carbons
Task C3 : Electrochemistry test

CREDDI
WP E : Economic model
Task E1 : Production of discontinuous supplies
Task E2 : Impact analysis of the use of fluorinated particles and bio-oil

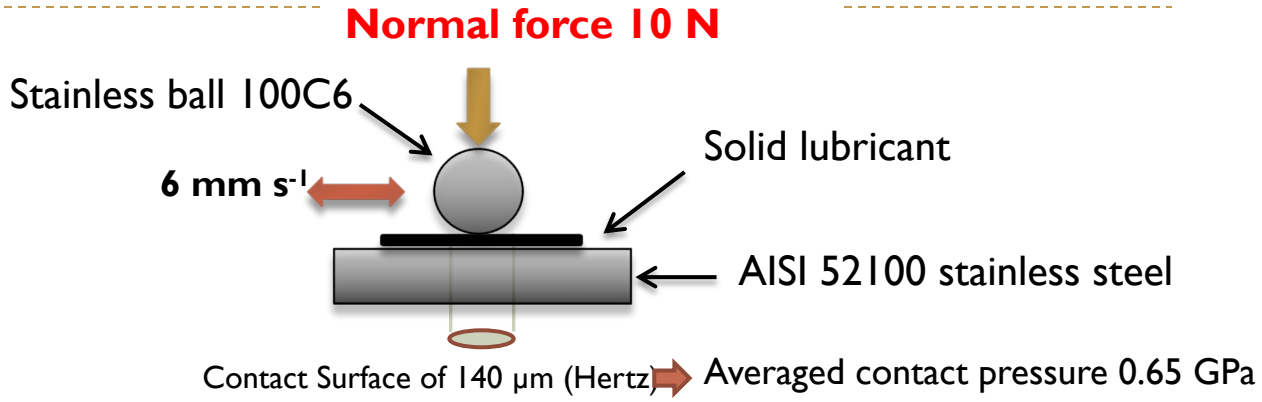
GTSI
WP A : Collection and project monitoring

Research questions addressed

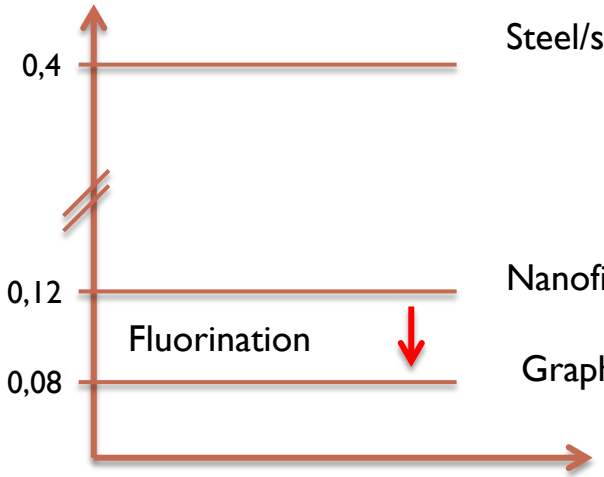
We will focus on the answers to the following questions:

- Advantages of Sargassum derived additives compared to conventional ones
- Effect of fluorination on lubricating performances
- Tribological properties of oils issued from Sargassum pyrolysis
- Efficiency of Sargassum derived carbons as electrode materials in Li primary batteries.
- Economic viability of the under vacuum pyrolysis process

Results expected



$\mu = F_N/F_L$



μ=0, 1

μ=0, 14 ± 0,02

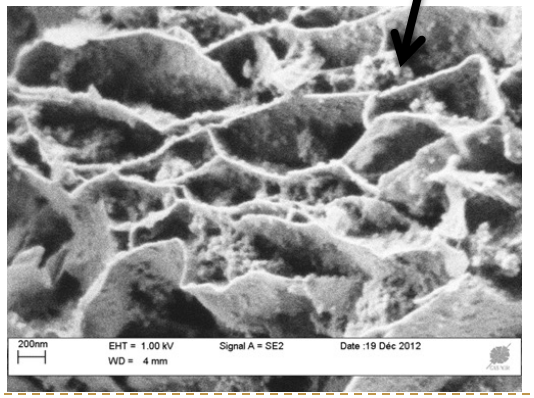
Results expected

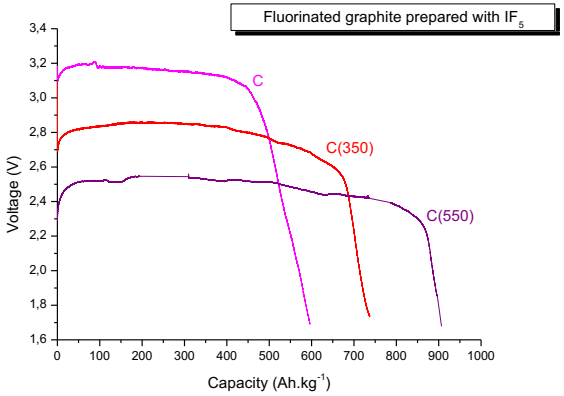
Lithium battery

$CF_x + xLi \rightarrow C + xLiF$

Porosity

Accommodation of formed LiF





Comparison of specific capacities

Institut de Chimie de Clermont-Ferrand

Added value/Dissemination/ perspective for development

Possibilities

- vacuum pyrolysis by-products with high added value
- Two pyrolysed phases not exploited
- A gaseous phases composed of incondensable gases
- A nitrogen rich aqueous phase

Not studied in this project

- could be used as fertilizer if there are no heavy metals after LCA analysis

Dissemination

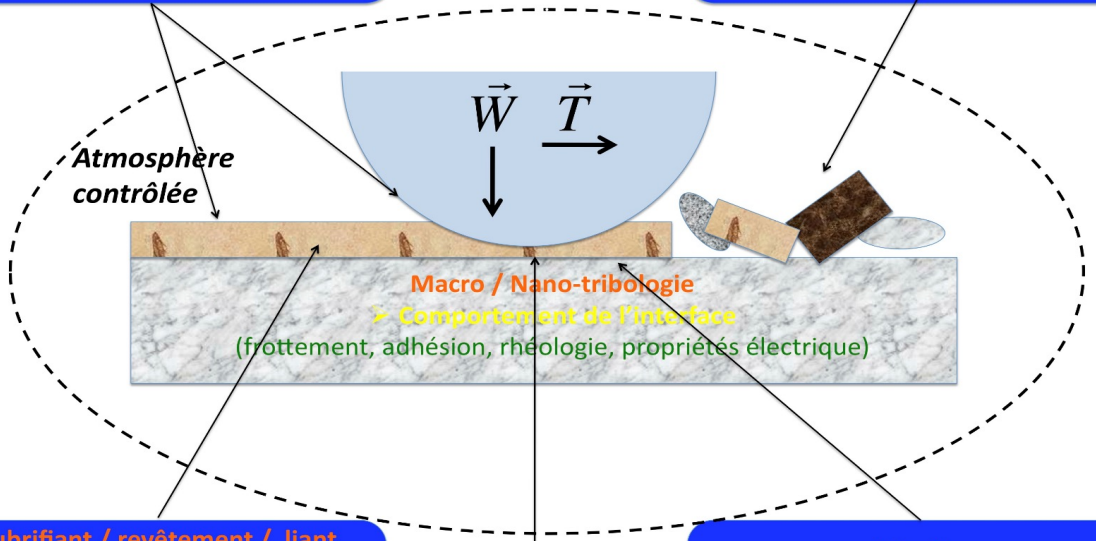
- Congress (oral and poster)
- National and international publications

Thank you for your attention

The consortium : GTSI

Matériaux / Surfaces
➢ **Caractérisation physico-chimique**
(MEB, MET, Raman, IR, FRX …)
➢ **Caractérisation mécanique**
(Dureté, traction compression…)

Surface endommagées
Surface de fracture
➢ **Caractérisation morphologique, structurale et chimique**
(MEB, MET, AFM, Raman, IR…)

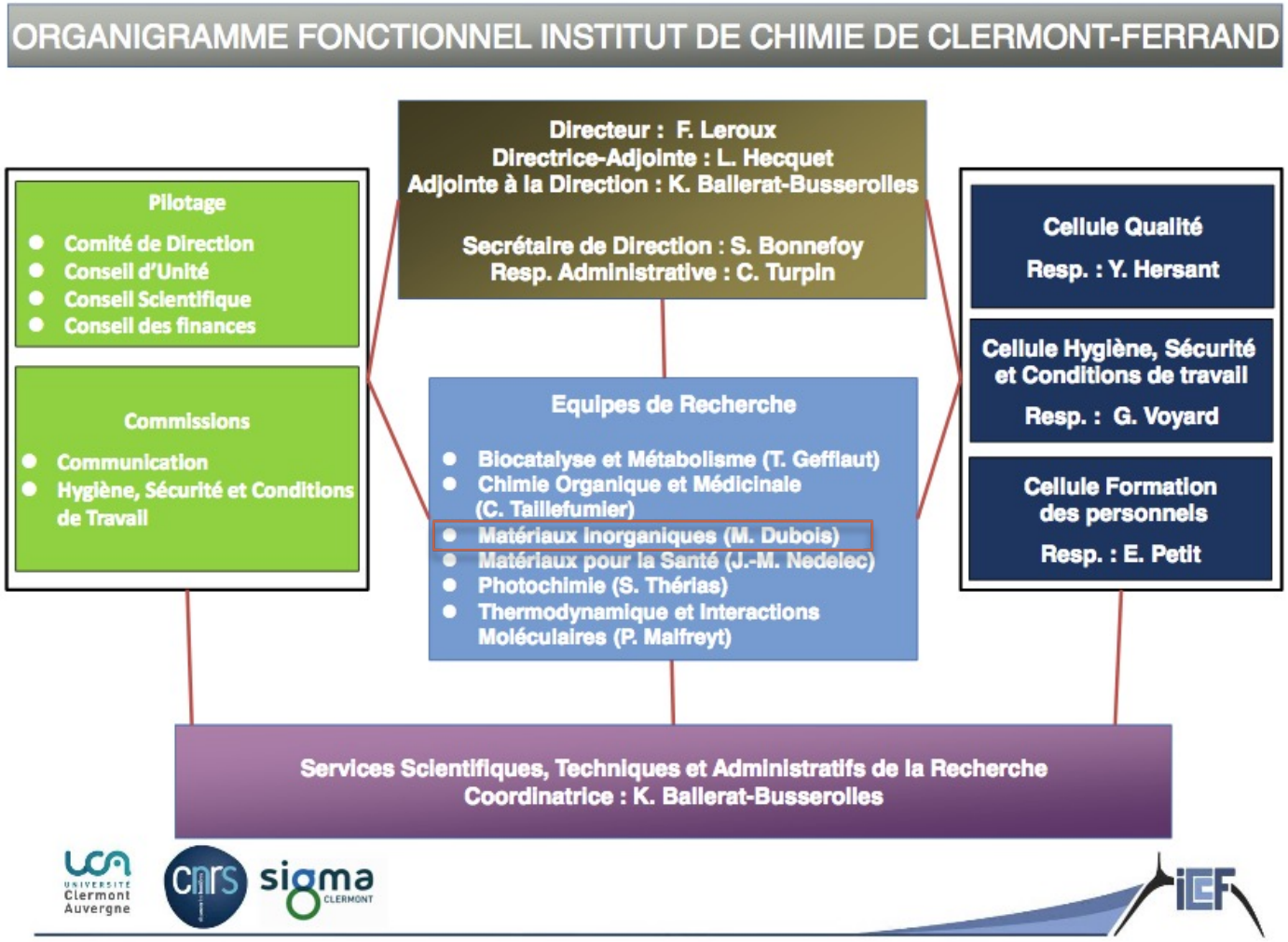


Lubrifiant / revêtement / liant
➢ **Synthèse, étude structurale et rhéologique**
(DRX, FRX, MET, Raman, IR,…)

Interface
➢ **Modélisation mécanique du comportement**

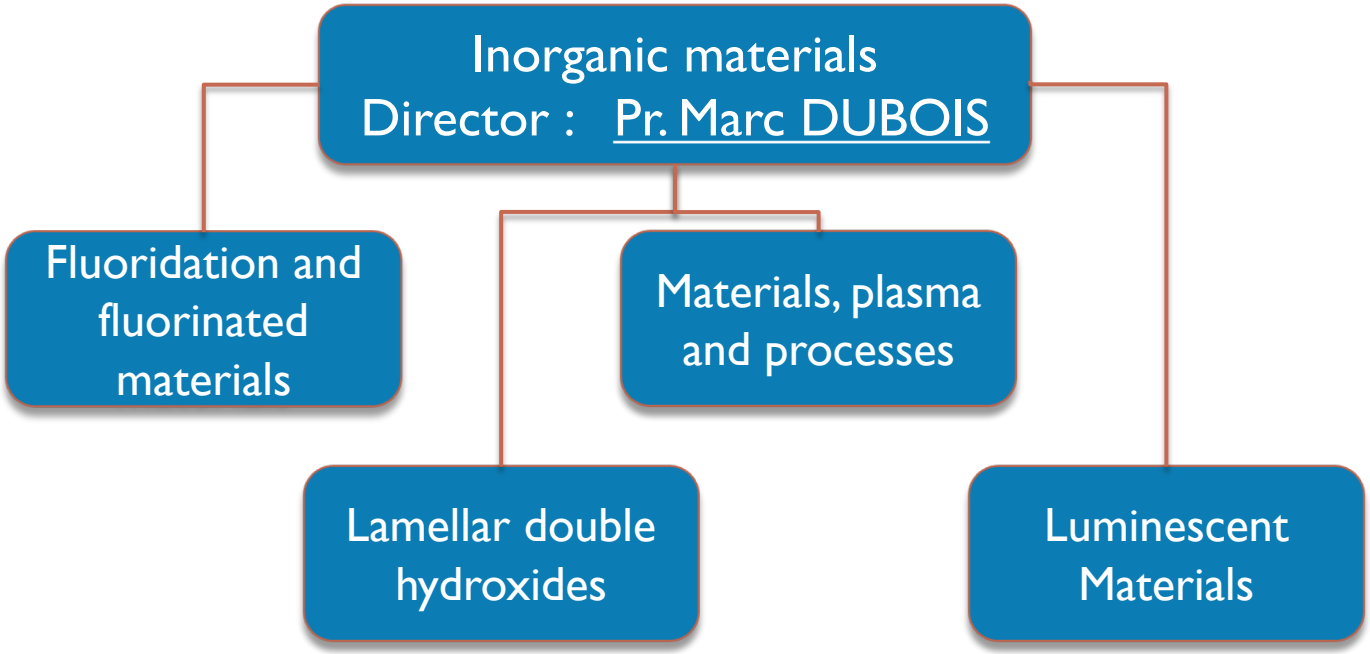
Étude in situ de l'interface sous contrainte
➢ **Mesure de paramètres physiques**
(pression, cisaillement, température)
➢ **Évolution du matériau interfacial**
(structurale, chimique, …)

The consortium : ICCF



The consortium : ICCF

Institut de Chimie de Clermont-Ferrand



The MI team is positioned on promising topics with **high societal challenges** such as **energy storage and management**, **eco-energy lighting**, **depollution**, and **reducing the environmental impact of processes**.

LCA
LABORATOIRE DE CHIMIE AGRO-INDUSTRIELLE

Biomass

- Agriculture
- Agro-industry
- Forest
- Food waste
- Microalgae
- Algae

Analysis

Processes

Mecanisms & modeling

Fractionation

Chemical reactivity

Bioproducts

- Agromaterials
- Surfactants
- Additives
- Solvents
- Lubricants
- Aromas
- Adhesives
- Pigments
- …

Life Cycle Sustainability Assessment Environmental LCA ; Life Cycle Costing ; Social LCA

INRA SCIENCE & IMPACT

INP ENSIACET

The consortium : LCA

LCA : UMR 1010 INRA/INP-ENSIACET
Director Pr. Carlos VACA-GARCIA

"Chemical Reactivity of Agromolecules - Lipochemistry" team
RCAML

"Fragmentation of Agroresources and Processes of Agro-industrial Transformation" team
FAPTA

''Analytical Engineering and Environmental Becoming of Agro-constituents''
GADEA

Research area
renewable carbon chemistry mainly derived from plant biomass

The consortium LCA

LCA LABORATOIRE DE CHIMIE AGRO-INDUSTRIELLE

Chemical Reactivity Team of Agromolecules – Lipochemistry
Manager DR Zephirin MOULOUNGUI

The consortium

- GTSI (Groupe des Technologies des Surfaces et des Interfaces) Université des Antilles

Tribology, Nanomechanic, Physico-Chemical characterization

- ICCF (Clermont-Ferrand Institute Chemistry)
- LCA (Agro-industrial Chemistry Laboratory)
- CREDDI (Center for Research in Economics and Law on Insular Development) Université des Antilles

AIMS of SarTrib

PYROVAC : Pyrolysis under vacuum Created by Christian ROY QUEBEC

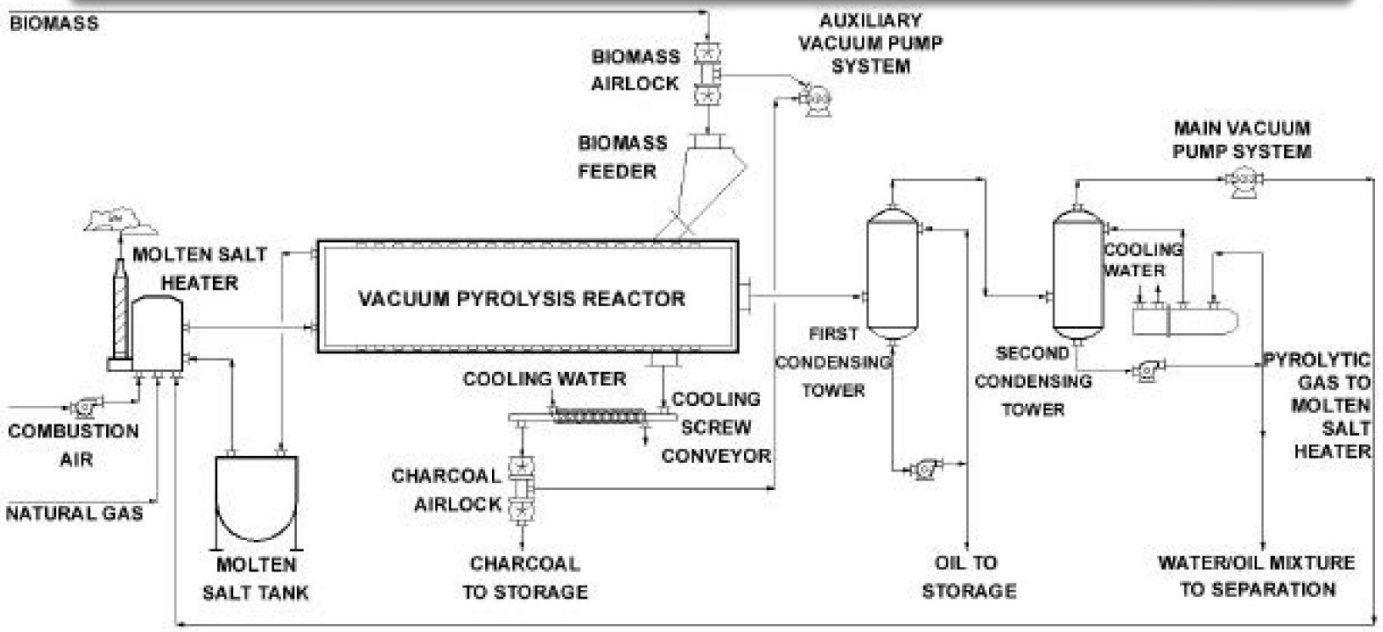


Figure 2: Pyrocycling™ Process Flow Sheet

A liquid phase (bio-oil) → Tribologic valorization

A solid carbon phase (bio-char) → Tribologic valorization / Electrochemical valorization

A nitrogen rich aqueous phase

A gaseous phase of incondensable gases

WP A : Collection and project monitoring GTSI

Task A1 : Project coordination GTSI

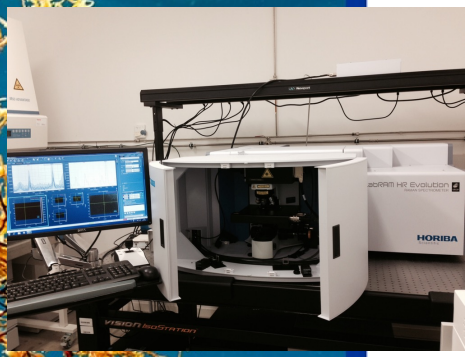
This involves organizing project monitoring and control, organizing project coordination meetings, specimen transfer procedures and planning progress reports. We plan at least one meeting every 6 months.

Task A2 : Collection GTSI (subcontractor SARA)

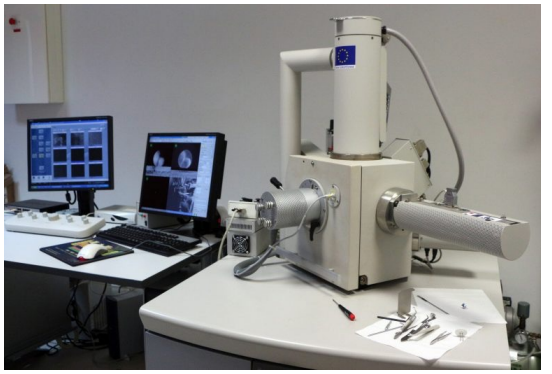
The collection will be devoted the Anonymous Company of the Refinery of Antilles, (SARA). It participates in the creation of an industrial unit of conditioning and recovery allowing the reception, the grinding and the dehydration of Sargassum algae.

WP B : Pyrolisis GTSI

Task B1 : Characterization of the biomass before pyrolysis GTSI-LCA



After separating the algae according to their collection locations and their decomposition states, the GTSI will mainly perform elemental analysis by X-ray fluorescence, to detect traces of arsenic or other heavy element.
The LCA will make the determination of the chemical composition of the biomass



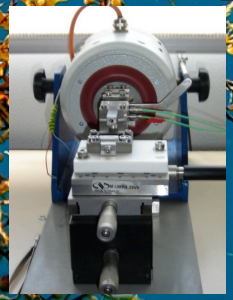
Task B2 : Pyrolysis GTSI (subcontractor PyroVac)

The pyrolysis will be done with our provider the company PyroVac in Quebec, Canada. The pyrolysis process is under vacuum, but we have the opportunity to vary the atmosphere and pressure. Particular care will be given to the setting up of pyrolysis parameters as they will be decisive for the physico-chemical properties of the by-products.

WP C : Characterization and Tribology GTSI

Raman, NIR,FT-IR

TEM



Tribometer

AFM

Task C1 : Characterization of pyrolized liquid phases LCA

LCA has all the skills to analyze and characterize the different compounds present in bio-oils and will also be able to carry out the elemental analysis of the pyrolyzed aqueous phase, in order to detect heavy metals

Task C2 : Characterization of pyrolized solid phases GTSI

These analyses will be performed using the equipment of the GTSI and the C3MAG. This step will also consist in selecting the particles intended for fluorination

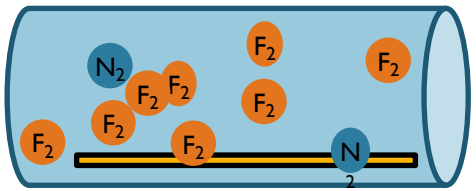
Task C3 : Tribology GTSI

- A sphere on plane tribometer that can measure the friction coefficient possibly at different temperatures The use of an environmental tribometer able to visualize a contact in real time and to realize Raman 'in-situ' spectroscopy in order to follow the structural evolution of the coal in a confined inter-facial space, under different pressures.
- The use of an atomic force microscope capable of performing mechanical measurements in a liquid medium

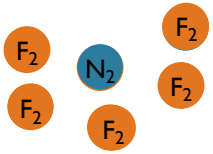
WP D Fluorination and electrochemistry

Task D 1 : Fluorination of porous biobased carbons, ICCF

Static fluorination



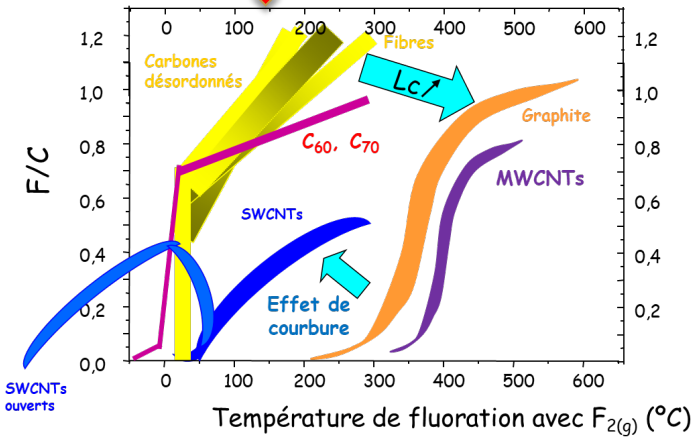
Sample



Dynamic fluarination

Sample

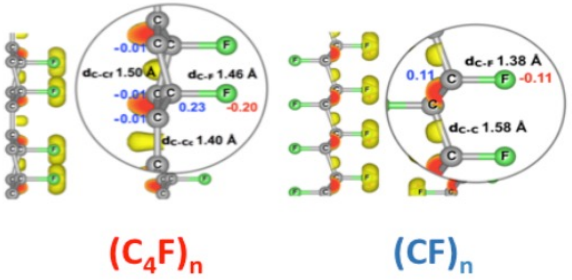
Carbones de SarTrib



WP D Fluorination and electrochemistry

Task D 2 : Characterzation of fluorinated carbon particles, ICCF

$$C_{(s)} + x/2 F_{2(g)} \rightarrow CF_x \quad x<4$$



Multitude of combinations → various applications

Nano-composites, adsorption of micro-pollutants, gas barrier (super) hydrophobicity, …

Sensors, contaminameters, microelectronics

Lubrication GTSI

Li primary batteries ICCF

0 0.1 0.5 1.0 **x dans CF_x (x= F/C)**

WP Economic model, CREDDI

Task E 1 : Production of discontinuous supplies

Multi-dimensional approach of a commercial productiive process

- random arrival Sargassum
- discontinuity of raw material supplies.
- material and environmental specificities.

Task E 2 : Impact analysis of the use of fluorinated carbonaceous particles and bio-oil

Macro-economic impact of particles and bio-oils produced → Macro-economic model development to assess the diversity of issues