



CRISMAT: activités “Mer et Littoral”

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IUT Caen, Université de Caen Normandie

Matériaux biosourcés:

- CaCO₃
- Lin (S. Eve)

Batteries – électrochimie (V. Pralong)

Thermoélectriques (F. Gascoin)

Caractérisation par rayonnements

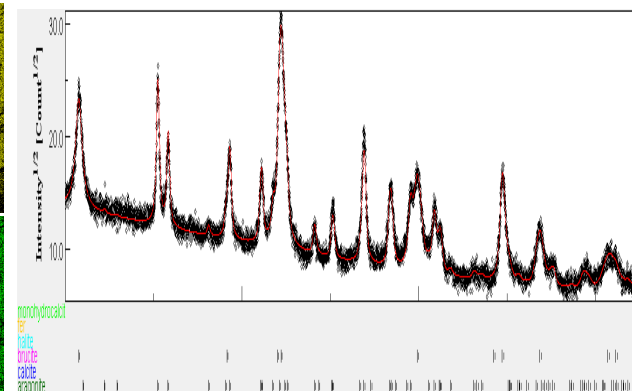
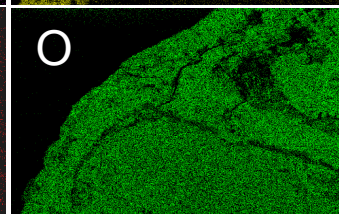
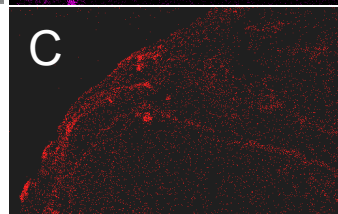
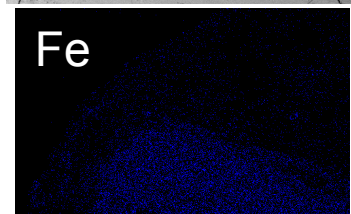
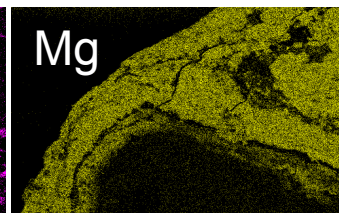
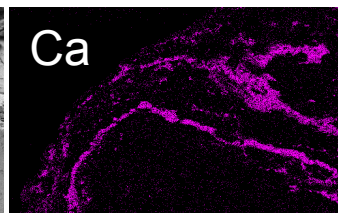
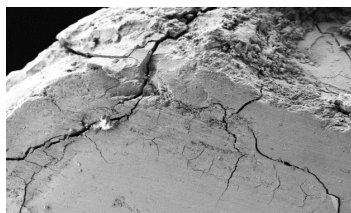
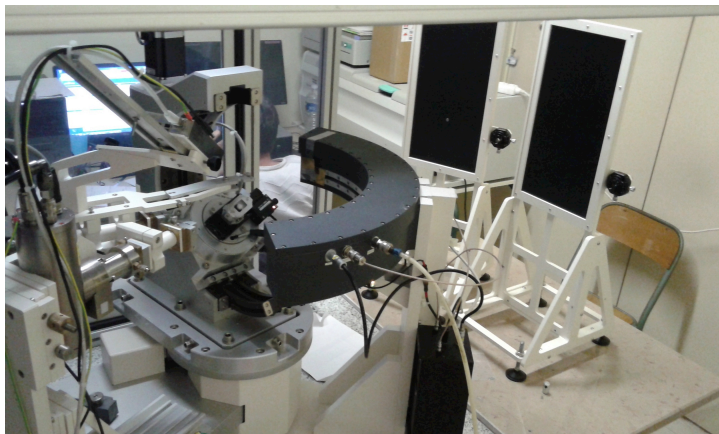
- 8 diffractomètres rayons X
- 3 MET (CNRT)
- 2 MEB-EBSD (R. Retoux, S. Gascoin)
- Accès grands instruments

Caractérisations mécaniques (M. Gomina)

Préparations (fours, SPS, microondes, chimie douce, ...)

± 150 personnes
(ED SIMEM)

Financed: 300k€ ANR + 80 k€ FEDER-CRBN
CRISMAT-ABTE, La Rochelle, Nouméa



- ✓ **Renforts côtiers**
- ✓ **Renforts d'ouvrages marins**
- ✓ **Création de néo-habitats marins (Interreg Arc Atlantique Nord-Ouest)**
- ✓ **Captage de métaux**
- ✓ **Captage de CO₂**
- ✓ **Recyclage direct de déchets coquilliers**
- ✓ **Recyclages direct de gravats, déchets bétonniers**

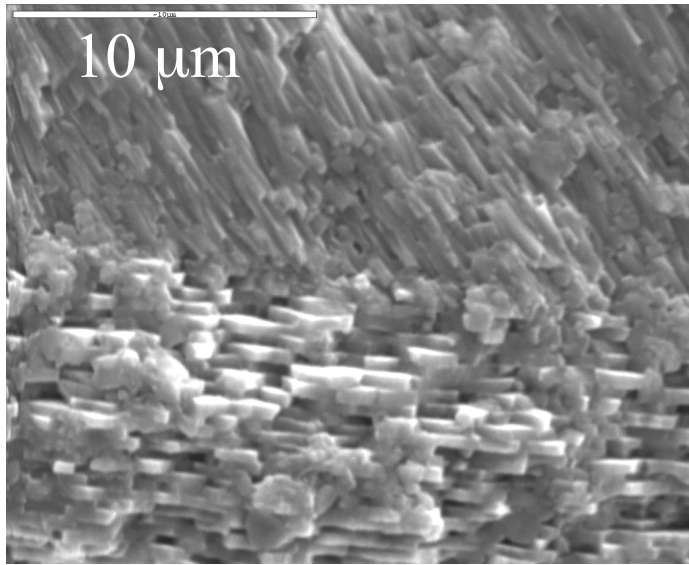
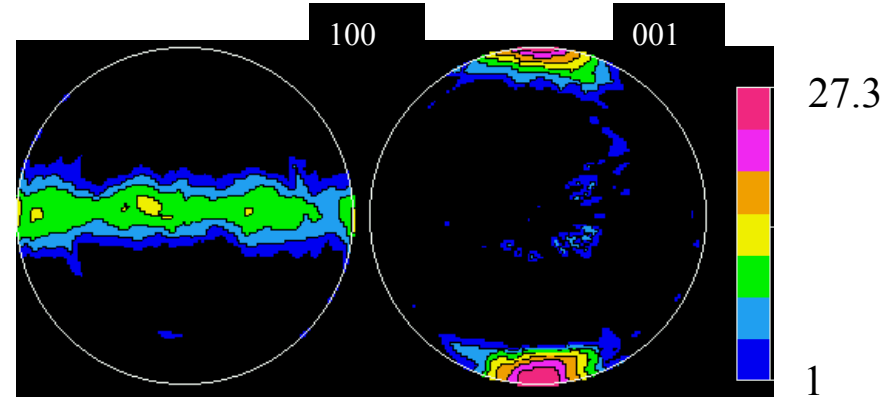
Dang Dan N'Guyen, Otavio Gil (ABTE)

Microstructure versus texture

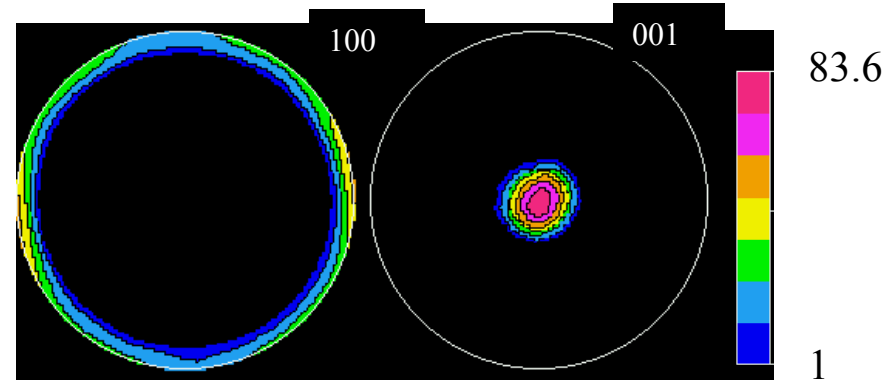


Bathymodiolus thermophilus (-2400m deep event mussel)

$$\langle \angle, 90 | \text{OFC} | I^{c,0} \rangle$$

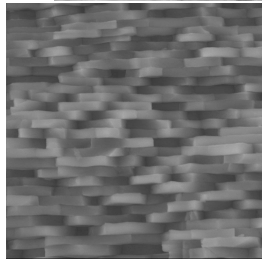


$$\langle \perp | \text{ISN} | *_{38}^{a,90} \rangle$$

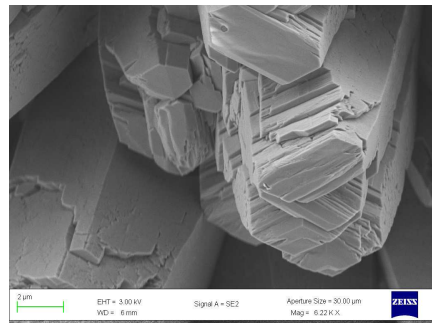


Nacre and implants (started 1996)

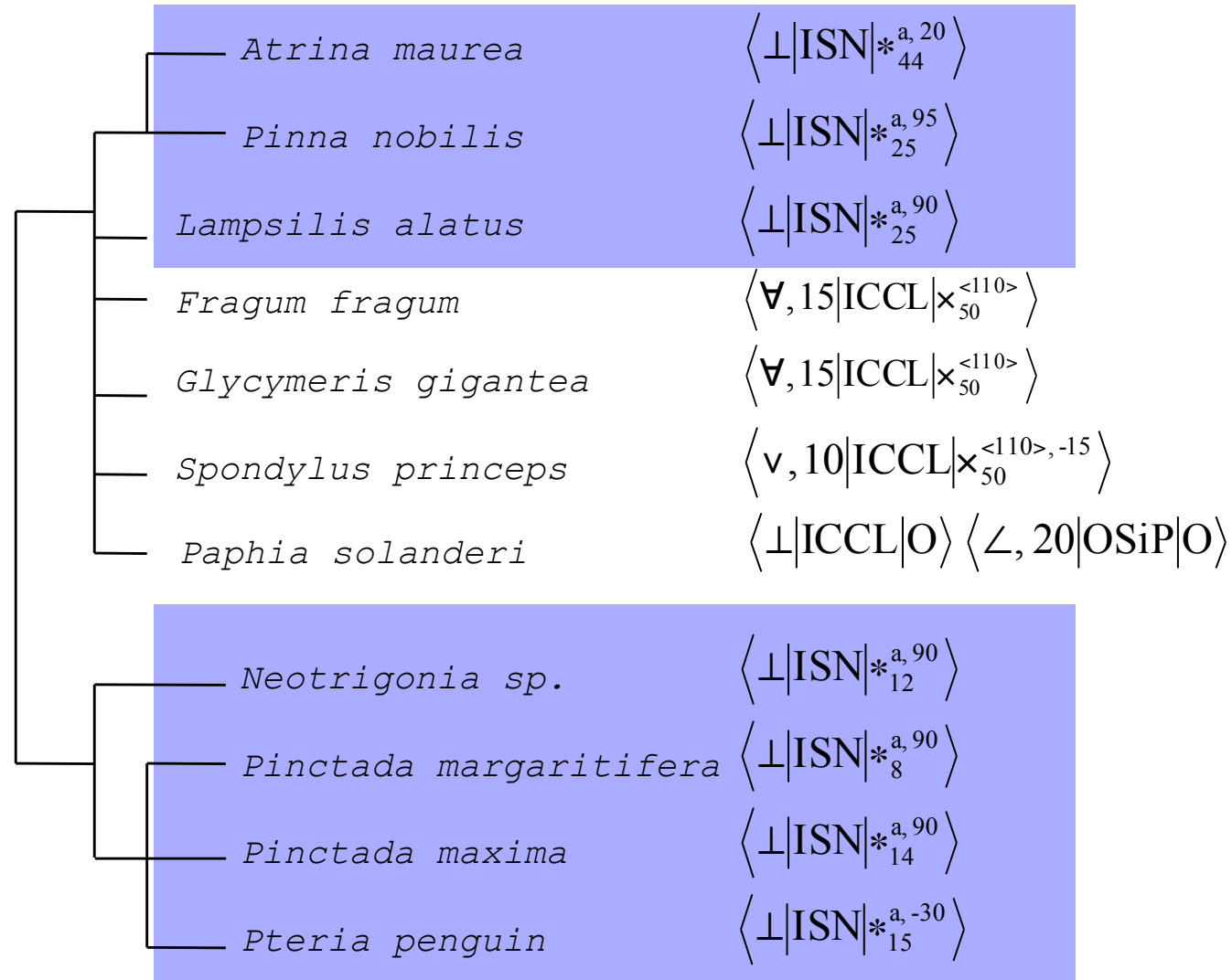
Pinctada margaritifera, *P. maxima* and *Pinna nobilis* nacres: Bio-compatible and **osteo-inductive** for human osteoblasts (E. Lopez (MNHN))



P. Margaritifera **Bivalvia**



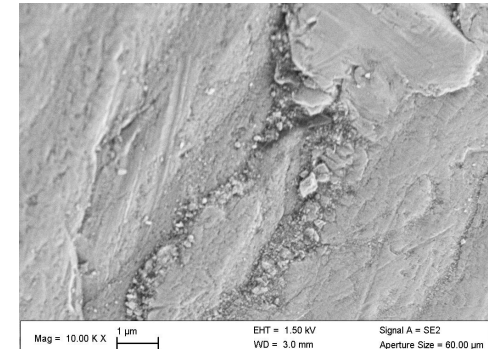
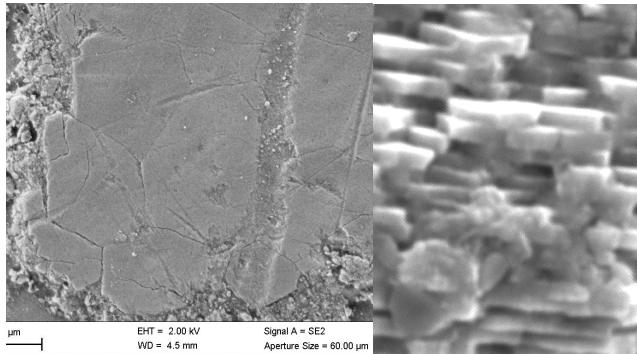
CaCO₃/Ti (Otavio Gil)



Financed: 30k€ Région Centre
CRISMAT, ISTO Orléans (X. Bourrat)



Hyriopsis cumingi (freshwater mussel), China

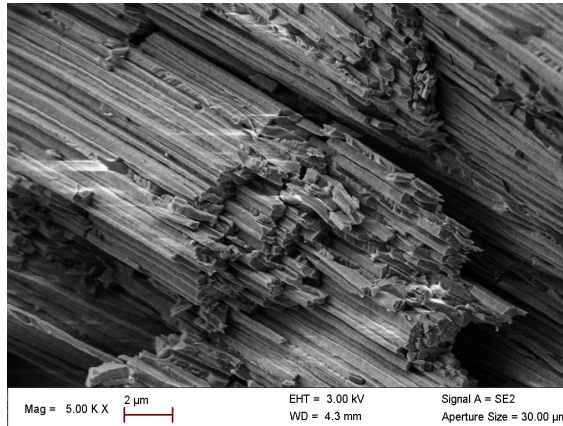


sheet nacre (aragonite)

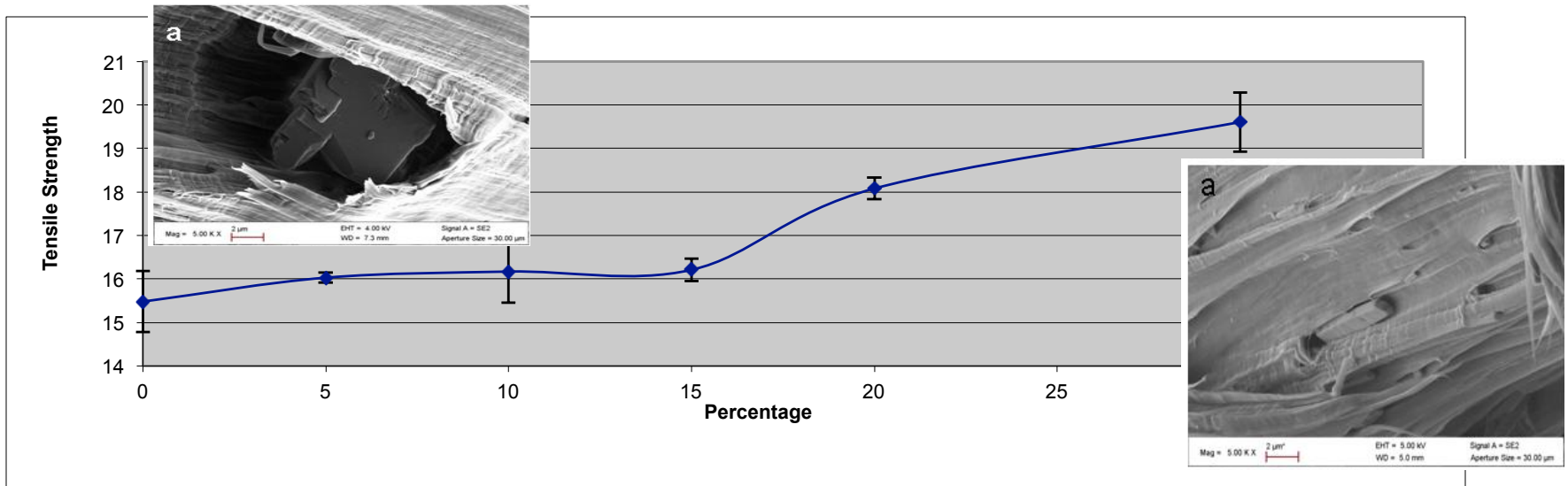
vaterite defect

Polymer reinforcement (from 2014)

LCMT (Loïc Le Pluart) – CRISMAT (Sophie Eve)

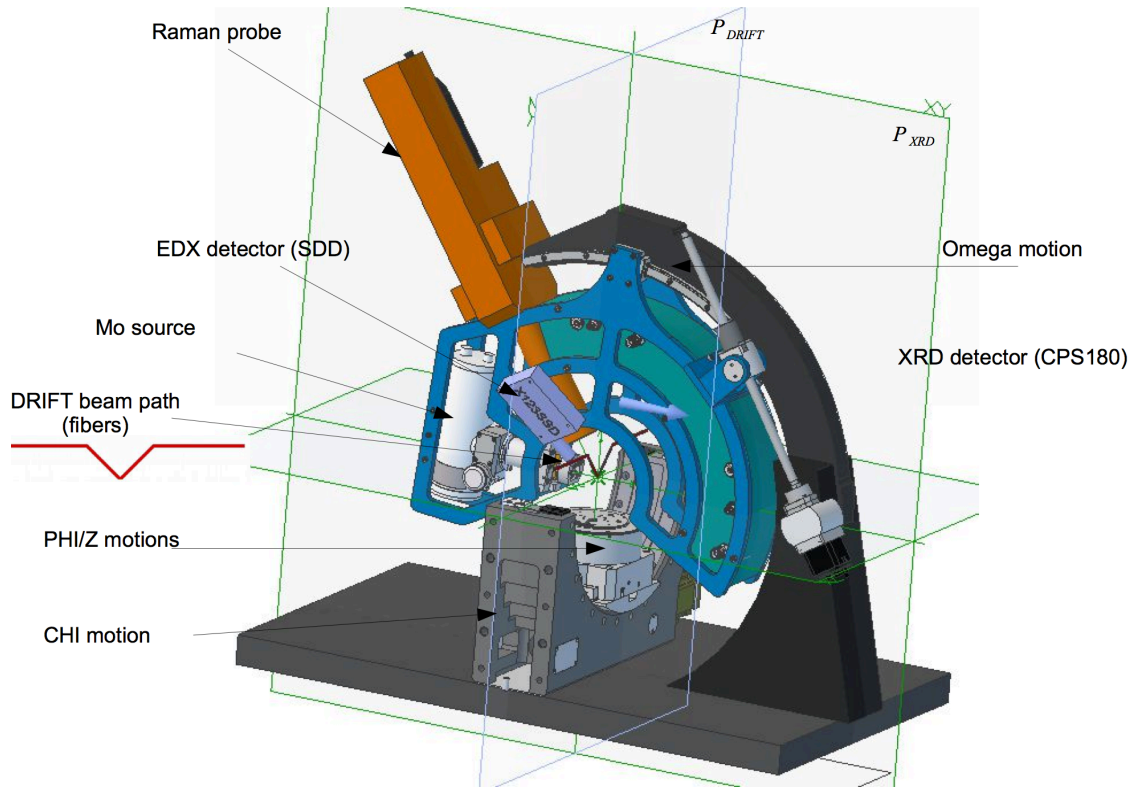


Pecten maximus
Crepidula fornicata
Crassostrea gigas



Financed: 10 M€ total, 1.3 M€ for CRISMAT

Acteurs: CRISMAT, ERAMET (SLN), SSD, BRGM, TU-Delft, Univ. Vilnius, Univ. Trento, Univ. Verona, Thermofisher



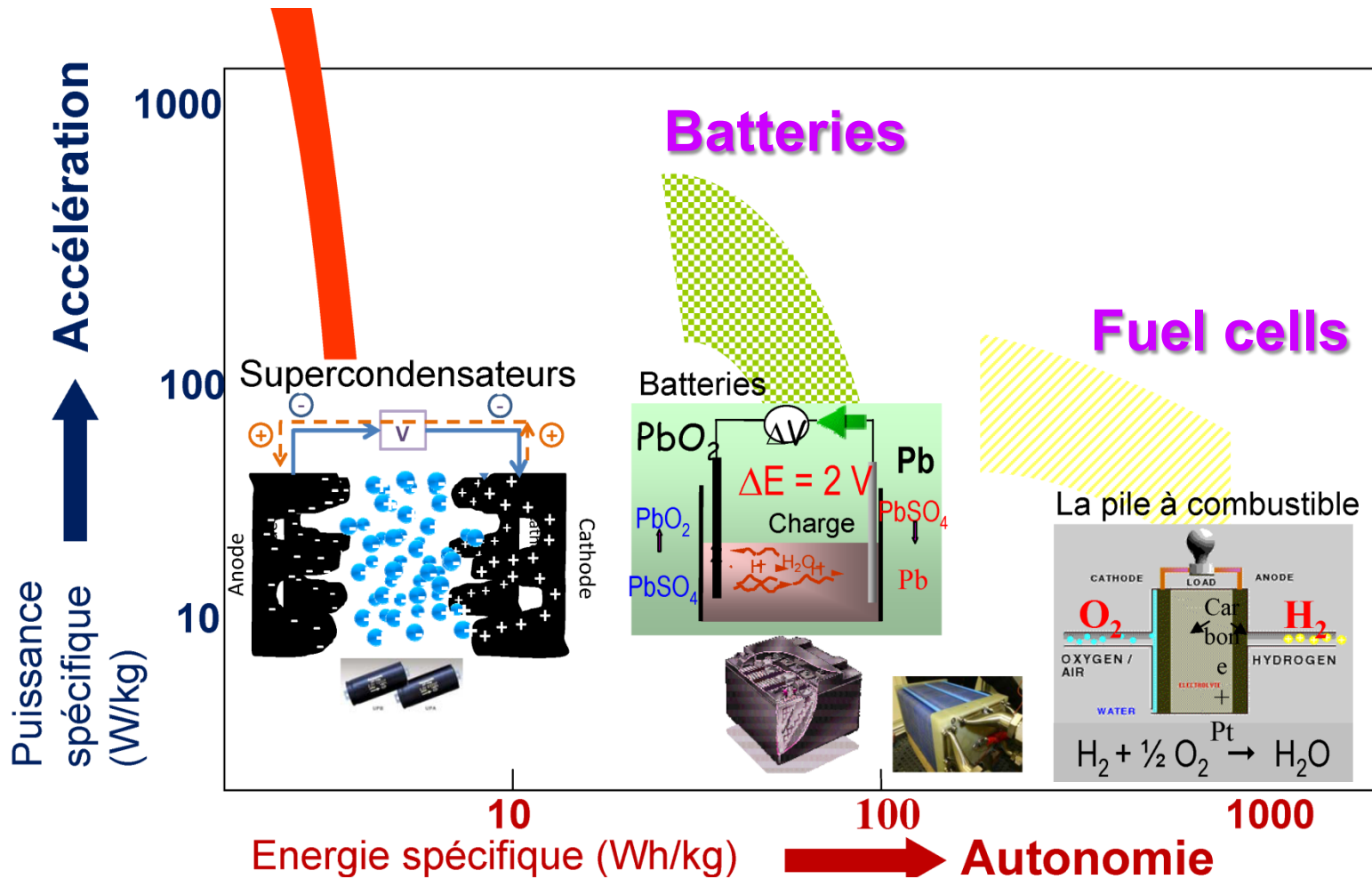
XRD-XRF-Raman-IR

On-line On-mine
Measurement + analysis

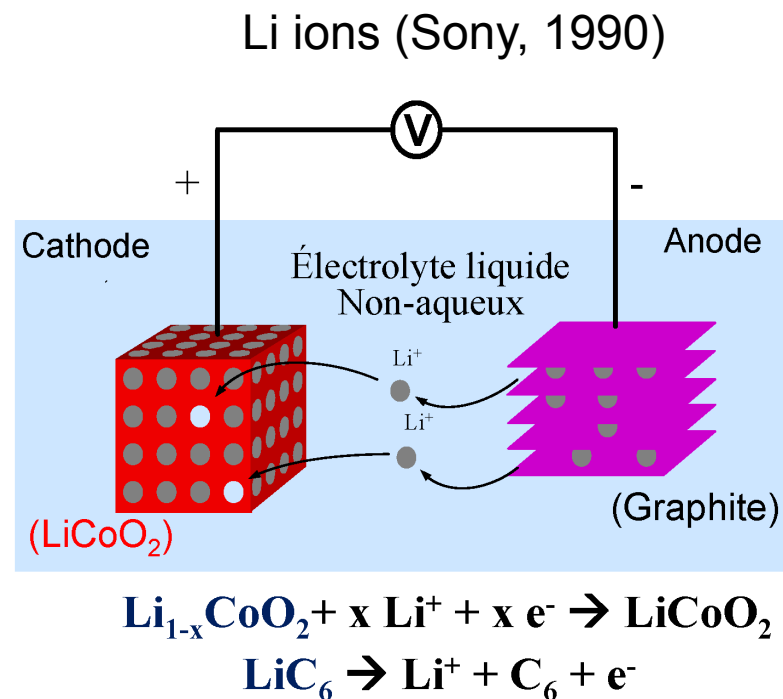
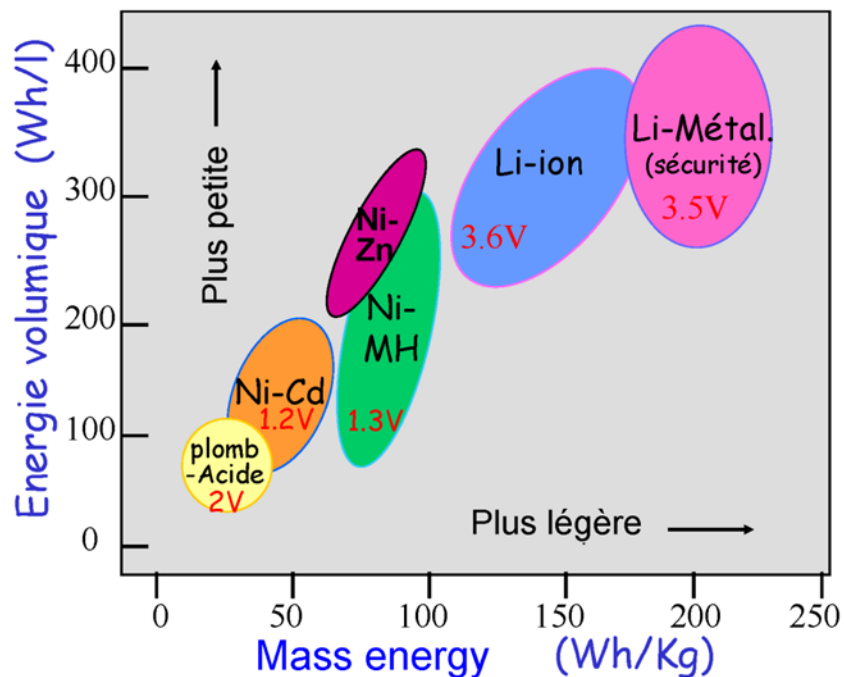
Société Le Nickel (Nouméa)

Heavy ions and metal traces

Batteries



How to design materials in solid state chemistry ?
 What are the main characteristics and challenges for materials in batteries and fuel cells ?



One of the best electrochemical advanced of the 20th century

Capacité Spécifique : $\text{Ah/kg} = \frac{26,8 \times \Delta x}{M}$

← Nbr d' e⁻ ou Li⁺

← Masse Molaire (kg)

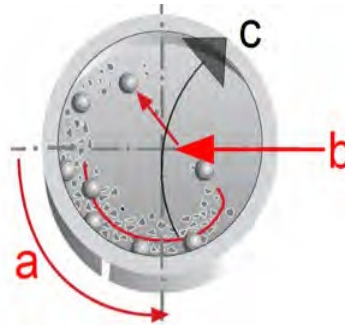
ANR DAME: as-prepared $\text{Li}_4\text{Mn}_2\text{O}_5$ □

Mechanochemical synthesis *



Grinding Bowl in tungsten carbide WC (+4 balls)

- Grinding time influences
 - Under Ar
 - 20 hours



→ « Nano » scale
Electrochemical Performances

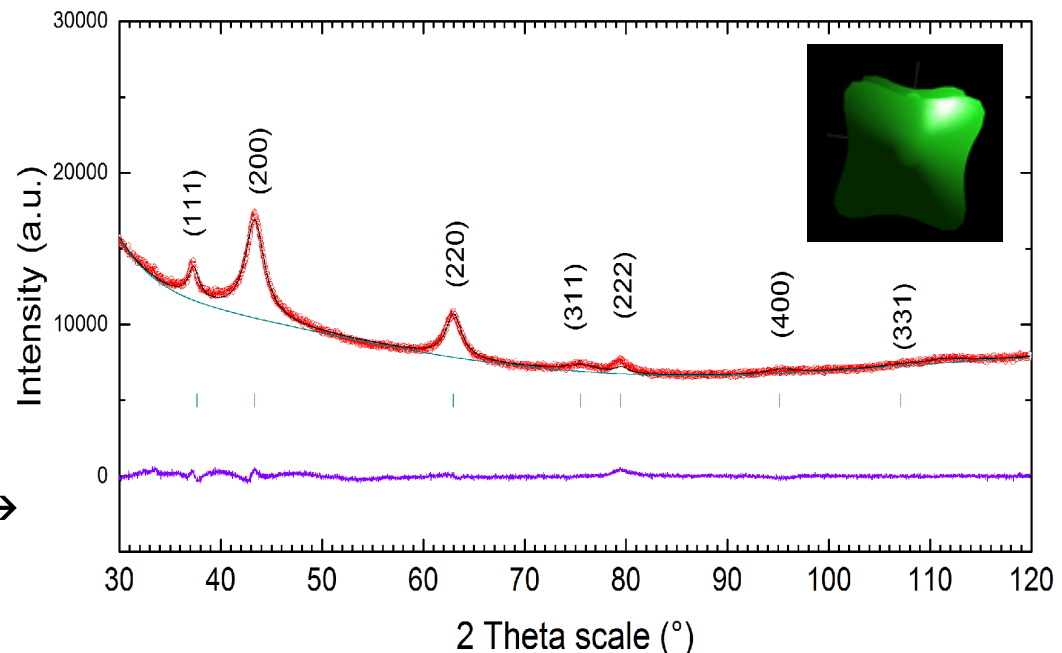


Amorphization

A priori:
 $Fm-3m$ space group
with the cell parameter $a=4.17(2)\text{\AA}$
 $\chi^2=1.53$

Disordered
rock salt type structure
16% oxygen vacancies

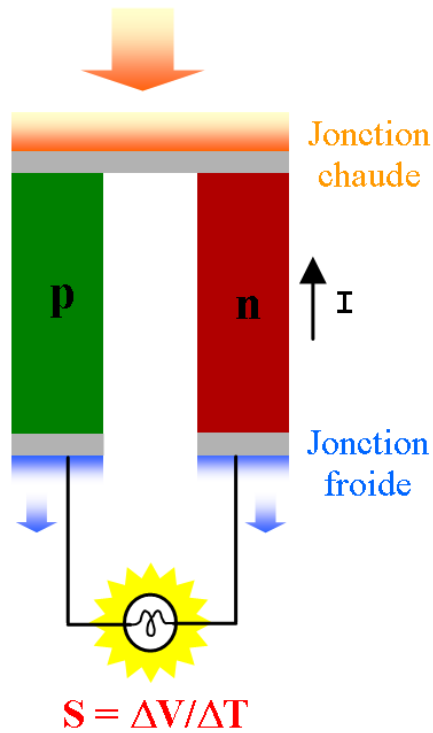
X Ray diffraction pattern →



Thermoélectricité

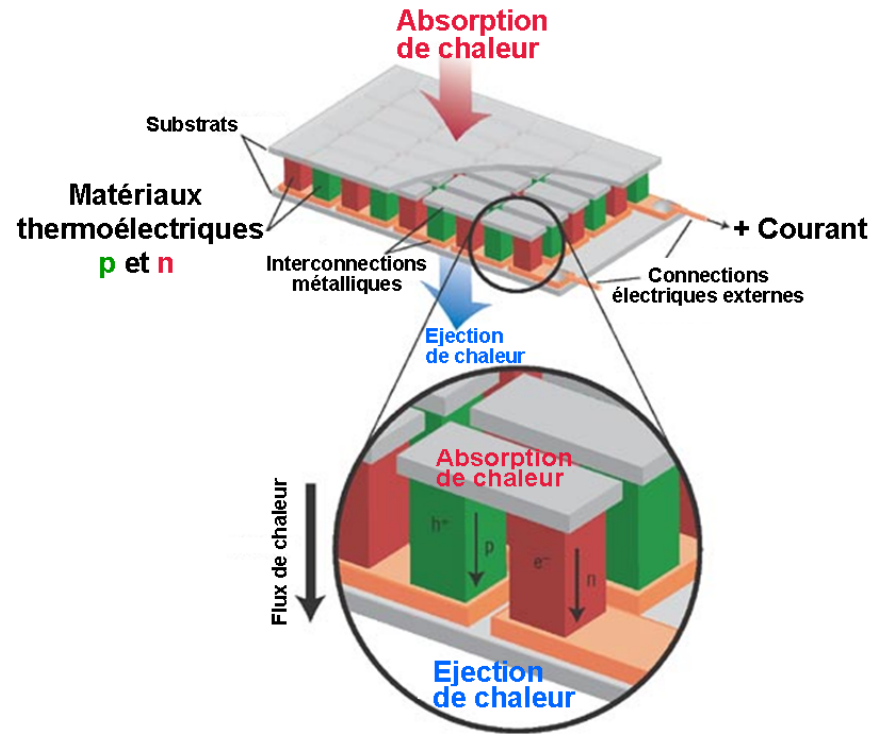


Effet Seebeck



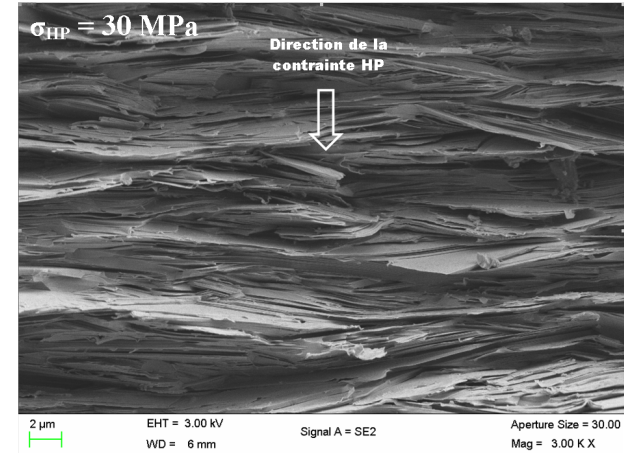
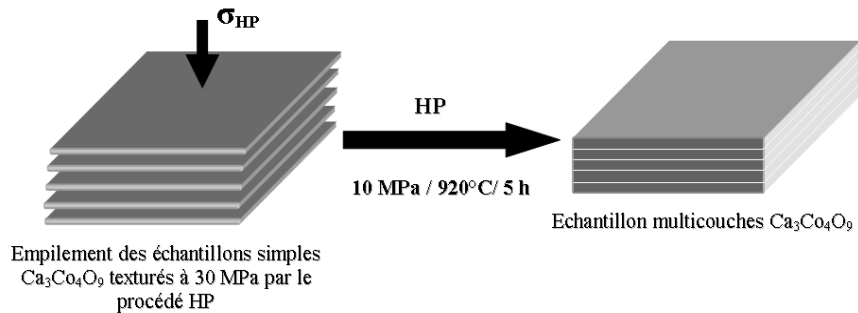
Génération d'électricité

Générateur Peltier



Puissance électrique

Matériaux épais multicouches (SPS)



- ✓ microstructure et alignement des plaquettes similaires à ceux d'une monocouche
- ✓ Soudage des monocouches entre elles (épaisseur d'interface $\leq 50 \text{ nm}$)

D. Kenfoui, J. Noudem

