

Institut des Matériaux Jean Rouxel – IMN UMR CNRS/Univ. Nantes 6502 (Thierry Brousse)



- ~ 200 (2/3 permanent researchers), 5 teams
- 31 permanent researchers involved in the GDR
- Synthesis, characterization and use of nanomaterials for energy
- 5, 8, 10, 13, 15 (CNRS), 28, 31, 32, 33, 63 (CNU)
- Axes:
 - Elaboration: synthesis of nanomaterials for various uses in the field of energy (storage, PV, ...)
 - Electrochemical properties
 - Fabrication of microdevices and evaluation of their performance

AXE
Élaboration
Mesures de propriétés
Mesures de performances de dispositif
Simulations/Théorie

5 équipes de recherche

PMN Physique des Matériaux et Nanostructures

Responsable : Laurent **CARIO**

MIOPS Matériaux Innovants pour l'Optique, le Photovoltaïque et le Stockage

Responsable : Stéphane **JOBIC**

ST2E Stockage et Transformation Electrochimique de l'Energie

Responsable : Olivier **JOUBERT**

ID2M Ingénierie Des Matériaux et Métallurgie

Responsable : Pascal **PAILLARD**

PCM Plasmas et Couches Minces

Responsable : Mireille **RICHARD-PLOUET**



Physics of Materials and Nanostructures (PMN)

NANOCARBONS

Design, construction, characterization and manipulation of individual nano-objects

- Nanomanipulation and spectroscopy
(*nanotubes, graphene, nanohorns,...*)
- Multifunctional composite nanowires
(*conjugated polymer-nanocarbon hybrids*)
- Computational nanocarbon 'design'

NANOSCALE ASSEMBLIES

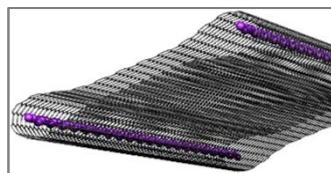
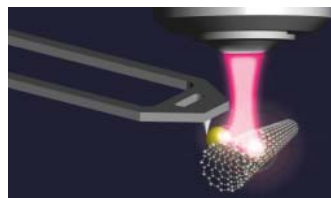
Physicamistry of interfaces and interactions in hybrid materials - biosystems

- Ionogels and Hydrogels
- Nanocarbon in bio-nanosystems
(*bio-nano crystals, protein membranes ...*)

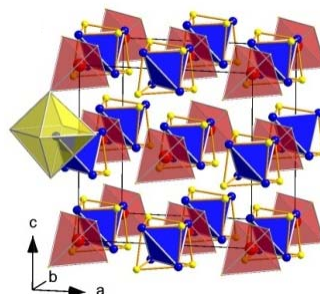
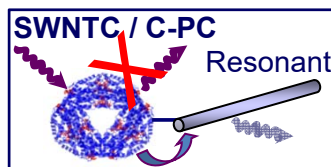
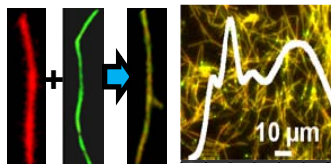
NOVEL ELECTRONIC MATERIALS

Design, synthesis and applications of complex materials with non-conventional electronic properties

- Resistive switching in Mott Insulators
- Non Volatile Memory and Artificial Neurons



core+shell 500-700 nm



EXPERTISE

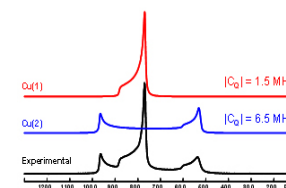
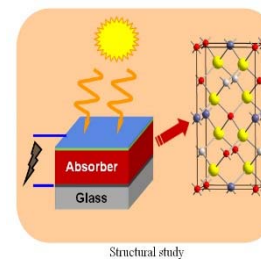
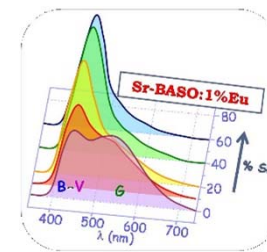
Inorganic Synthesis
Ionic Liquids, Carbon Materials
Optical Spectroscopy (Raman, ...)
Transport measurements
Microscopy (AFM, TEM)
Atomic-scale modelling



Matériaux Innovants pour l'Optique, le Photovoltaïque et le Stockage (MIOPS)

OXIDE MATERIALS

- Pigments and UV absorbers
- P-type conductive transparent materials
- Thermochromism and tribochromism
- Magnetic materials
- Gem materials
- Luminescent materials
- Materials for photocatalysis
- Zinc oxide



CHALCOGENIDE MATERIALS

- Crystallochemistry
- Photovoltaic materials
- Device fabrication and performance evaluation

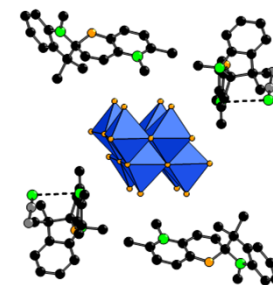
HYBRID MATERIALS

- Photochromic and photoluminescent hybrid organic-inorganic materials
- New plasmonic nanostructures for photocatalysis and SERS applications



EXPERTISE

Inorganic and hybrid organic-inorganic synthesis
Thin film deposition
Optical spectroscopy
Crystallography
Surface/Interface analysis
Theoretical modeling



Storage and Transformation of Energy Electrochemically (ST2E)

LITHIUM BATTERIES

- Design of electrodes formulations and processings
- Organic batteries and eco-compatible storage
- New technologies of batteries (Li-S, sodium...)
- Microbatteries

SUPERCAPACITORS

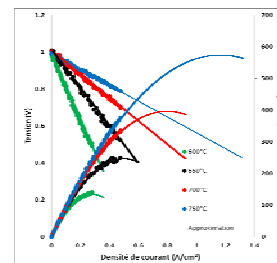
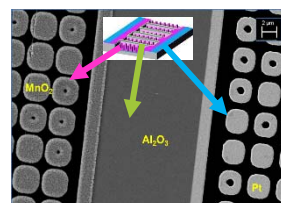
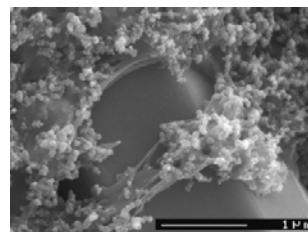
- New materials/New molecules
- New devices (Li-ion capacitors, micro-supercapacitors...)

NEW MATERIALS FOR HIGH TEMPERATURE FUEL CELL AND ELECTROLYSER APPLICATIONS

- New materials
- Functional ceramic materials
- Fuel Cell and electrolyser cell design and test

SPECTROSCOPY AND MODELING

Comparison experiment/theory of electronic structures of solids



EXPERTISE

- Inorganic/organic Synthesis and grafting
- Electrode Formulation
- Electrochemical devices
- Spectroscopic and microscopic analysis
- Operando techniques
- Performance Optimization
- Simulations and calculations



Ingénierie des Matériaux et Métallurgie (ID2M)

GEOMATERIALS AND ENVIRONMENT

- Development of eco-friendly materials
- Trace elements in contaminated environments

METALLURGY

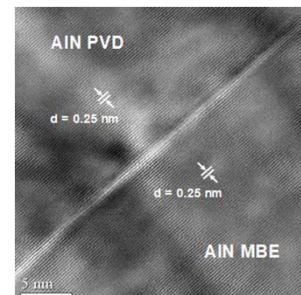
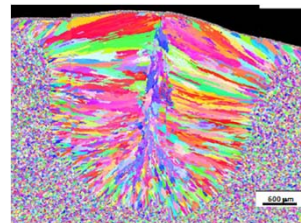
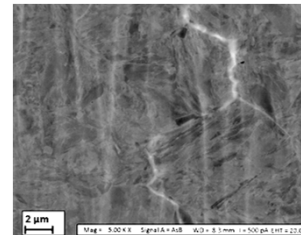
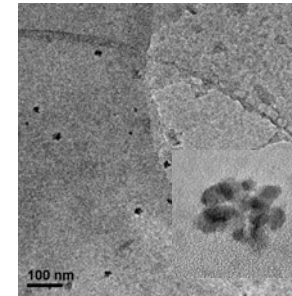
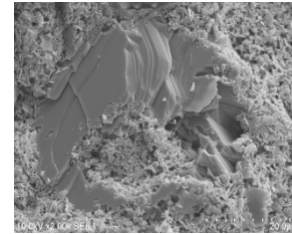
- Relations between composition, processing, microstructure and properties :
- Metallurgy of joining (welding, brazing...)
Forming metallurgy (rolling, forging...)
- Phase and structural transformations
- Computational alloy design

INTERFACES AND DEFECTS

- Atomic-scale modelling of interfacial segregation
- Ab initio techniques
- Monte Carlo, Molecular Dynamics simulations

THERMAL MATERIALS

- Deposition and integration of thin films of nitride materials with good thermal properties



EXPERTISE

Metallic/natural materials
Optical Spectroscopy
Transport measurements
Microscopy (TEM, AFM)
Modelling
Thermal properties of thin films



Plasmas and thin films – Plasmas et couches minces (PCM)

NANO-OBJECTS AND NANOMATERIALS

- Nanocarbon, nanotubes, nanowires, nanocomposites, nanoporous films

HOMOGENEOUS THIN FILMS

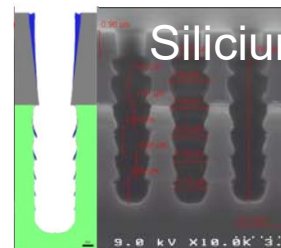
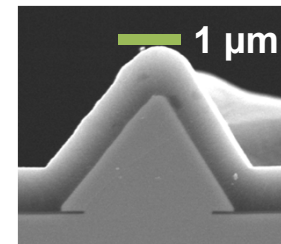
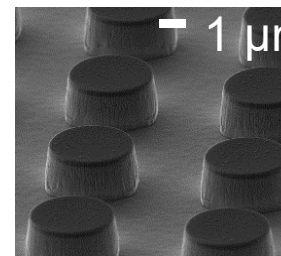
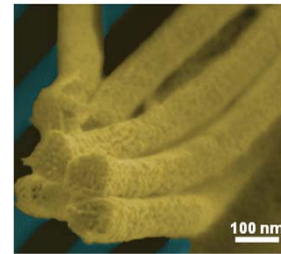
- Oxide, nitride, ternary functional materials
- PVD, HIPIMS, PECVD, Chemical Solution Deposition

PLASMA ETCHING

- Semi-conductors & dielectrics
- Experimental studies
- Multi scale and Monte Carlo modelling

APPLICATIONS

- Energy
- Flexible electronics
- Micro- & nano-technology
- Opto-electronics
- Semi-conductor technology
- Sensors
- Surface treatments



EXPERTISE

- Low pressure plasma processes & chemically assisted deposition,
- *In situ* diagnostics of plasma and growing thin films,
- Characterization of layers and interfaces
- Multi scale and Monte Carlo modelling.



Scientific expertise, overview, major themes in relation to the GDR

- Design, synthesis and understanding
- Type of energy conversion: PV, electrochemical (conversion and storage)
- Microbatteries, microsupercapacitors, sensors, energy harvesting

Porteurs d'énergie
Electron
Type de conversion d'énergie
Photovoltaïque
Electrochimique
Application relative à l'énergie ou autre
Récupération
Stockage
Capteurs
Microbatteries, microsupercondensateurs

μ to mWh/cm², μ to mW/cm²

Technical or technological expertise in relation to the GDR issues

- Metal and alloys, oxides, nitrides, carbides, polymers, composites, hybrids,...
- Bottom-up and top-down approaches
- Soft chemistry, thin film depositions
- XPS, HREM/EELS, electrochemical techniques,...
- Operando: XAS coupled with cyclic voltammetry

Caractéristiques physicochimiques
Caractérisation microstructurale
Electrique
Thermique
Mécanique
Magnétique
Autre ?
Type et taille caractéristiques des nanomatériaux
Élaboration
Caractérisation d'objets
Simulations

Looking for collaborations: coupling of microdevices (energy harvesters and microbatteries, interconnecting microdevices, ...