Institut Jean Lamour IJL (Nicolas Stein)

- permanent staff 273 in 4 departments
- Area of expertise of the lab :
  materials, metallurgy, plasmas, surfaces, electronics and nanomaterials

AXE
Élaboration
Mesures de propriétés

- 12 people involved in the GDR distributed in 3 research groups
- CNRS INC 15 and univ. section 31, 32, 33
- preferential axes
  - thin films and nanoparticules for photovoltaic conversion and thermochromic effect
  - carbon materials for energy conversion and electrochemical storage
  - Thin films and 1D nanomaterials for thermoelectric conversion

N A M E

GDR Nanomaterials for Energy Applications

ELABORATION
MEASUREMENTS & METROLOGY
SIMULATIONS & THEORY
APPLICATIONS

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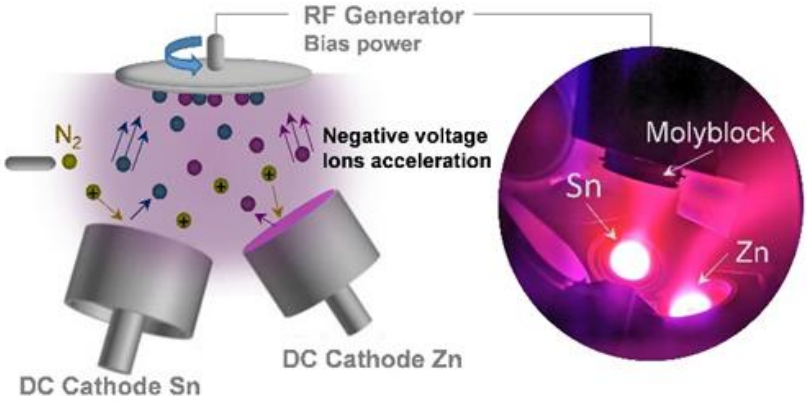
cnrs

Thin films and nanoparticules for photovoltaic conversion and thermochromic effect

- **Main research topic:**
  - ✓ Synthesis of new materials in thin film form ($MgSnN_2$, $ZnSnN_2$)
  - ✓ Deposition of VO_2 on large surfaces
  - ✓ Transparent p-n junctions
- **Type of energy conversion:**
  - ✓ Solar absorbance → Electron / hole generation
  - ✓ Solar absorbance → Heat
- **Two main applications:**
  - ✓ Photovotaics
  - ✓ Thermal solar

Porteurs d'énergie
Phonon
Electron
Type de conversion d'énergie
Photovoltaïque
Solaire thermique
Application relative à l'énergie ou autre
Récupération
Capteurs
Gestion thermique des nanodispositifs
Dispositifs flexibles
Performances/fiabilité des nanodispositifs



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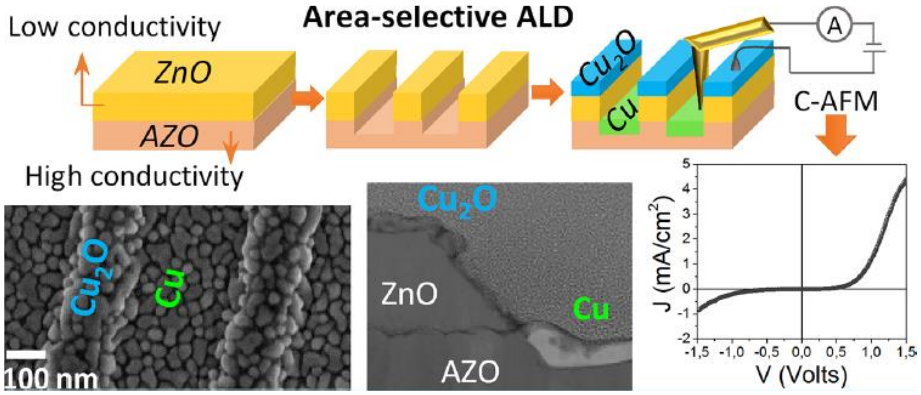
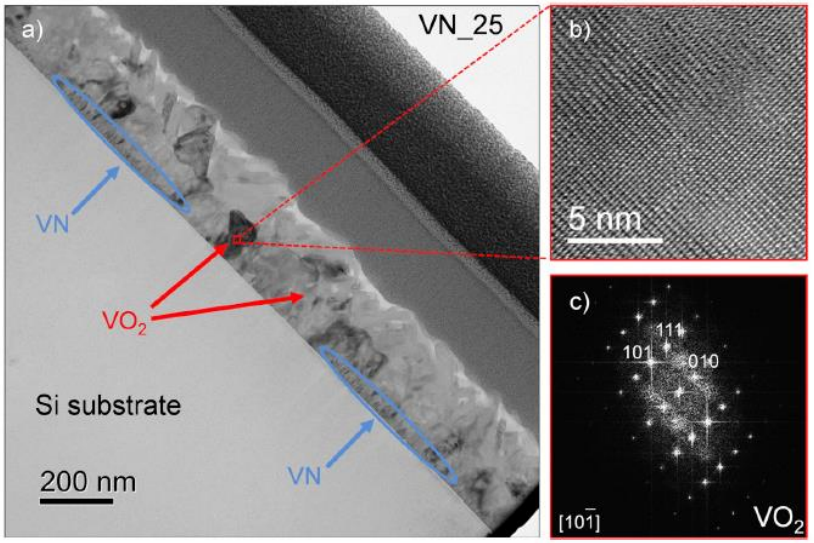
Thin films and nanoparticles for photovoltaic conversion and thermochromic effect

- Oxide and nitride thin films deposited by reactive magnetron sputtering and atomic layer deposition
- Nanoparticles obtained from laser ablation of thin films
- The group has a strong expertise in HRTEM and EELS characterization

Caractéristiques physicochimiques
Caractérisation microstructurale
Electrique
Optique
Type et taille caractéristiques des nanomatériaux
Élaboration
Caractérisation d'objets





Looking for collaborations on *ab initio* calculations

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Carbon materials for energy conversion and electrochemical storage

Main research subject

- synthesis and design of new low dimensional carbon materials
- modification of their properties by chemical treatments
- applications of these materials in the field of energy storage and conversion

Type of energy conversion

Mainly electrochemical conversion

Applications

- Li/Na or K-ion batteries
- Fuel cells
- Superconductivity
- Flexible electronics

Porteurs d'énergie
Ions
Électrons

Type de conversion d'énergie
Électrochimique

Application relative à l'énergie ou autre
Conversion
Stockage
Dispositifs flexibles

Carbon materials for energy conversion and electrochemical storage

Materials
- graphenic materials
- nitrogen-doped graphene foams
- hard carbons

Bottom-up method
- solvothermal synthesis
- chemical reactions
- pyrolysis under pressure

Top-down method
- exfoliation

Caractéristiques physicochimiques
Caractérisations structurale et texturale
Électrochimique
Électrique
Type et taille caractéristiques des nanomatériaux
Films
Nanomatériaux mis en forme
Electrodes

Characterization techniques
- structural characterizations of 2D materials by X-ray diffraction coupled with 1D modelling of stacking sequences
- quantitative analysis of surface properties by adsorption volumetry (N_2, CO_2, Kr …)
- electrochemistry

Thin films and 1D nanomaterials for thermoelectric conversion

main research subject

- electrochemical synthesis of low dimensional materials (semi-conductors)
- Investigations on the influence of the low dimensions, the chemistry and the microstructure on their transport properties

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Which heat carriers and type of energy conversion

- Phonon, electrons
- Thermoelectric conversion

Applications

- Energy harvesters
- thermoelectric microgenerators (µTEG)
- autonomous sensors (heat flux sensors, thermal power sensor)
- Thermal management (peltier effect) at microscale

Porteurs d'énergie
Phonon
Electron
Photon

Type de conversion d'énergie
Thermoélectrique

Application relative à l'énergie ou autre
Récupération
Capteurs
Gestion thermique des nanodispositifs

Depends on the amount of couples of TE compounds and the thermal gradient range of µW/cm^2 with mV Seebeck voltage for ΔT 1-20K.

Thin films and 1D nanomaterials for thermoelectric conversion

- **Nanowires, nanotubes, core@shell nanowires**
  Diameter 10 nm -200 nm
  Length 100 nm – 50 µm

- **Materials**
  $(Bi,Sb)_2(Te,Se)_3$,SnSe, metal sulfur, ZnO …

- **Bottom-up approach : electrodeposition**
  by template synthesis
  by self assembly mechanism
  Aqueous solvent or ionic liquid

- **Specific Characterizations**
  Seebeck Microprobe (PSM-II Panco) (local) for thin films (10µm lateral resolution)
  Collective and Individual Seebeck measurements of nanowires at RT

Caractéristiques physicochimiques
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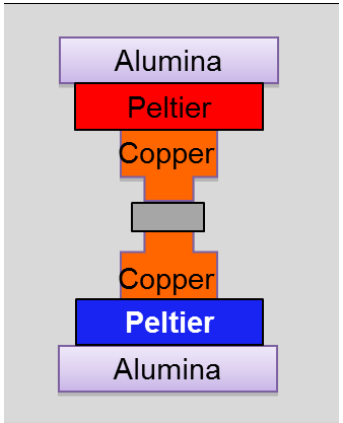

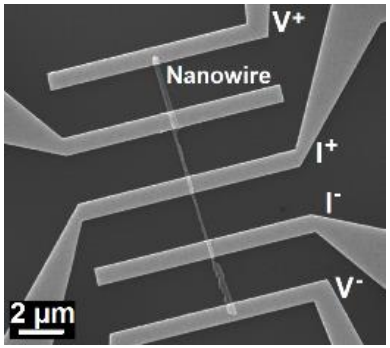

Looking for collaborations : device integration