ITheMM: Institut de Thermique, Mécanique, Matériaux
Nicolas Horny

- Number of people: 52 EC
  - **Matériaux et Procédés Innovants**
  - **Mécanique Appliquée et Génie Civil**
  - **Thermique**

- Number of people involved in the GDR: 6
  - Jean-Stéphane Antoniow
  - Mihaï Chirtoc
  - Abdel Elhdiy
  - Jaona Randrianalisoa
  - Nathalie Trannoy

- ~~CNRS and/or~~ University section:
  - ✔ 28ème : Milieux denses et matériaux (2)
  - ✔ 62ème : Énergétique, génie des procédés (4)

Area of expertise of the labs - Which preferential axes ?

- ✔ Thermophysical properties measurement,
- ✔ Developpement and characterization of experimental set-up (PTR, 3ω et SThM)
- ✔ Simulations (Monte-Carlo and finite elements): prediction of thermal properties of nanostructures and their behavior under stress

N A M e
GDR Nanomaterials for Energy Applications
ELABORATION
MEASUREMENTS & METROLOGY
SIMULATIONS & THEORY
APPLICATIONS

iTheMM
Institut de Thermique, Mécanique, Matériaux

Université de Reims Champagne-Ardenne

cnrs

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

Back bone of the labs regarding chemistry or physics (main research subject)

- ✔ Thermal properties of thin films or irradiated layers (0.1 to 50 $W.m^{-1}.K^{-1}$),
- ✔ Thermal boundary conductance (TBC) : up to 10^3 $MW.m^{-2}.K^{-1}$),
- ✔ Thermal anisotropy,
- ✔ PCM thermal characterization and PCM/substrate TBC,
  10 to 20 $W.m^{-1}.K^{-1}$ or 20 to 40 $W.m^{-1}.K^{-1}$
- ✔ SThM.

- Which heat carriers ?
  - ✔ Phonon + electron + photon

- ~~Type of energy conversion~~

- What kind of applications are targeted ?
  - ✔ Energy harvesting: tuning *k,* superlattice,
  - ✔ Storage: PCM,
  - ✔ Thermal management of nanodevices : TBC,
  - ✔ Performance / reliability of nanodevices

Technical or technological expertise in relation to the GDR issues

- What kind of materials/dimensions
  - ✔ Multiphysics from 10 nm to few µm,
  - ✔ Interfaces,
  - ✔ Nanostructured materials, irradiated materials
  - ✔ Nanocomposites: graphite, nanowire, graphene (on size ≈ 10 nm)
  - ✔ Nanofluids (nanoparticles)

- ~~What kind of elaboration techniques~~

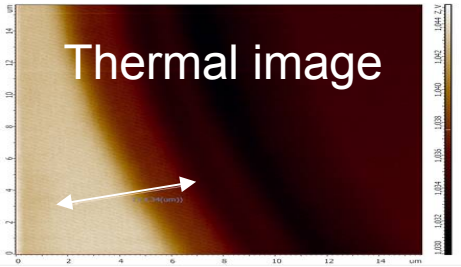
- What kind of characterization technique are mastered by the lab/group/team
  - ✔ SThM (10-200 nm)
  - ✔ PTR (few µm to TBC)
  - ✔ 3ω (nanofluids and gaz)
  - ✔ Monte-Carlo (>20 nm)
  - ✔ Finite Elements (multiscale)

- Codes/numerical tools/modelling
  - ✔ Comsol, Abaqus (thermo-mecanical multiphysic), Monte-Carlo

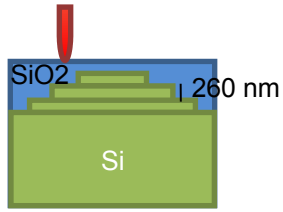
- Looking for collaborations
  - ✔ Fabrication of nanostructured samples
  - ✔ Ab-initio simulation data for mesoscopic modeling

SThM

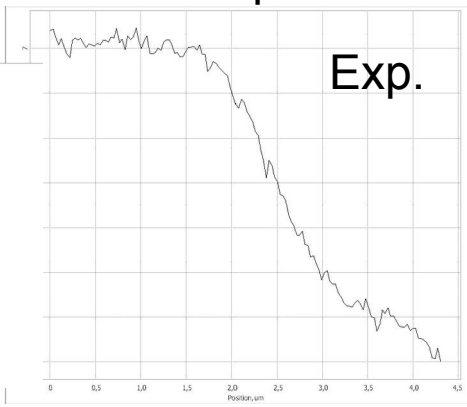
Interpretation of thermal measurement by SThM at multiscale;
Modeling of thermal behavior of thermal probe in nanostructured materials (Wollaston and KNT probes) with **thermo-electrical coupling.**

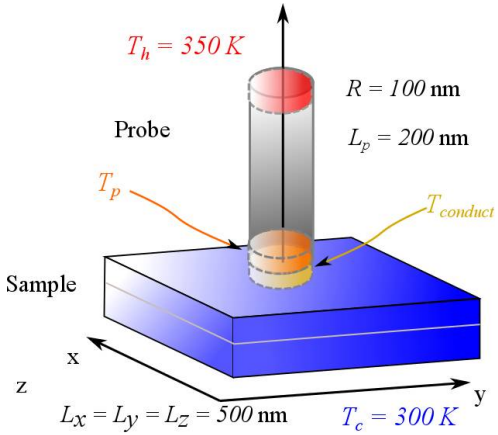


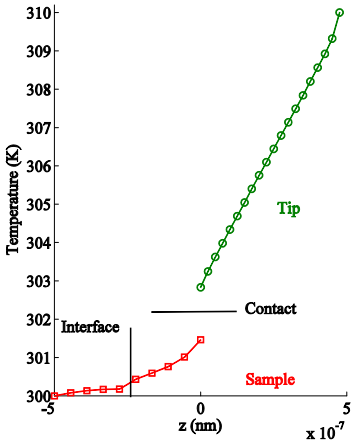
Simulation of heat transfer in nanomaterials and across interfaces at nanometric scale by Monte Carlo simulation

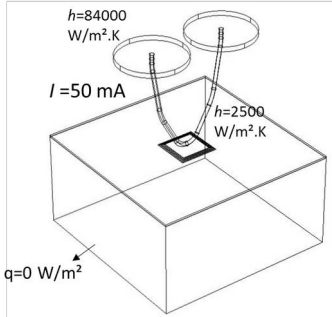


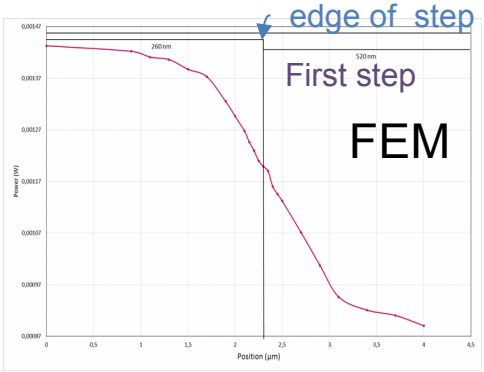
Thermal profiles



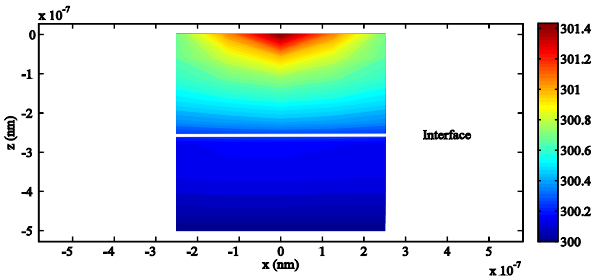




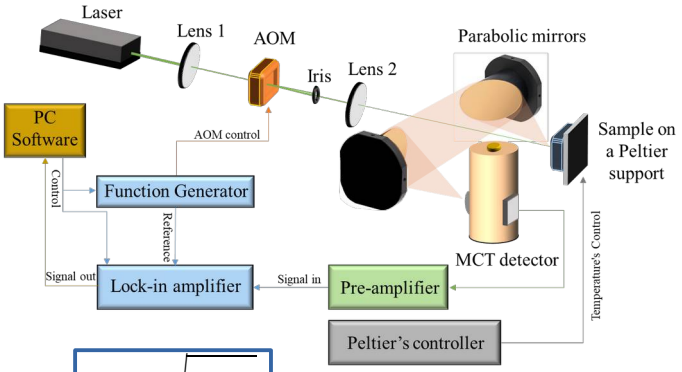




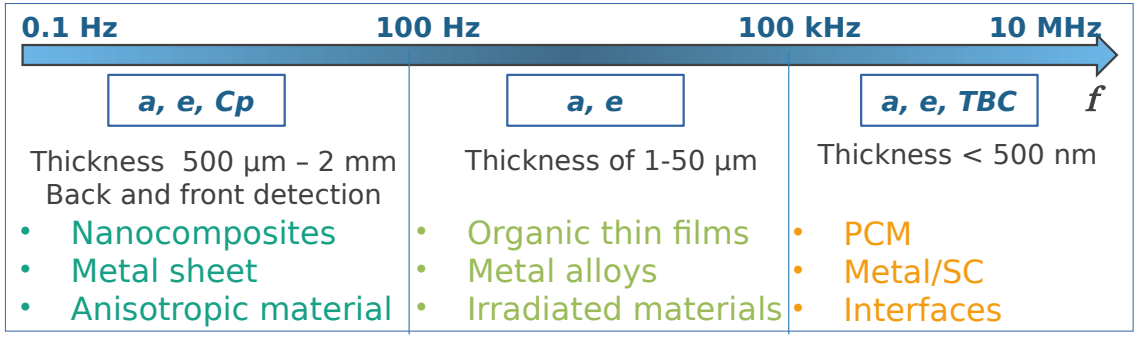
Results for with an interface at nm



Photothermal radiometry: multiscale thermal characterization



$$\mu = \sqrt{\frac{a}{\pi f}}$$



- Study of doping level on TBC,
- Anisotropy of thin films,
- Metal/Dielectric transition of VO_2