

Centre for Energy and Thermal Sciences of Lyon - CETHIL (P-Olivier Chapuis)

~110 membres, including ~ 40 faculties and
permanent researchers



- **Heat transfer and energy systems** (5 research themes)
- CNRS Sec. 10 / CNU 62

- **'Micro and Nanoscale Heat Transfer'** (MiNT) research theme
with 5 permanent researchers/faculties (~15-20 members in total)

P.-O. Chapuis, S. Gomès, S. Lefèvre, O. Merchiers, K. Termentzidis



- **Main GDR axes:**
 - Measurements of properties (*Mesures de propriétés*)
 - Simulation/Theory
- + some activity on Measurements of device performances
(*Mesures de performances de dispositifs*)



N A M e

GDR Nanomaterials for Energy Applications

ELABORATION
MEASUREMENTS & METROLOGY
SIMULATIONS & THEORY
APPLICATIONS

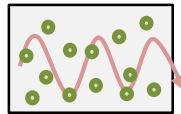


Nanoscale energy transport and conversion

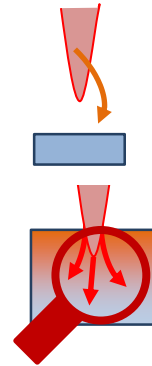
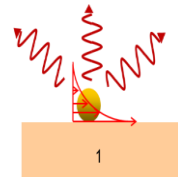
Modeling
&
simulation

Thermal
nanometrology

Phonon and charge
conduction



Thermal radiation



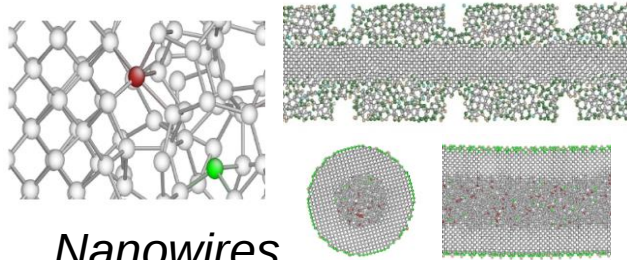
Developing
characterization tools

Measurements **of**
materials & devices

Phonons: from atomic to macroscopic scale

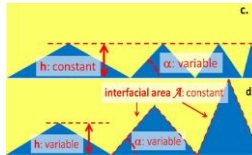
‘Atomistic approach’: Molecular Dynamics

PRB 103, 014202 (2021)
JAP 126, 164305 (2019)
Nanoscale 10, 21732 (2018)



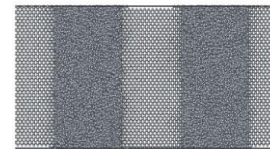
Nanowires

*Equilibrium,
Non-equilibrium,
Wave-packet*



Interfaces

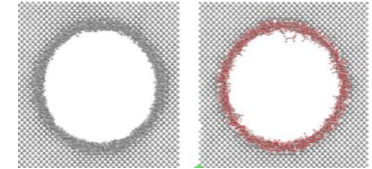
Solid-solid, solid-liquid



Superlattices

Confinement

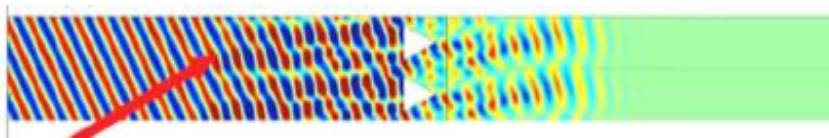
Amorphous



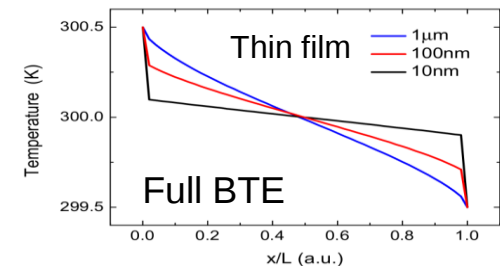
Porous

Dislocations, etc.

‘Wave approach’



‘Particle approach’: Boltzmann equation

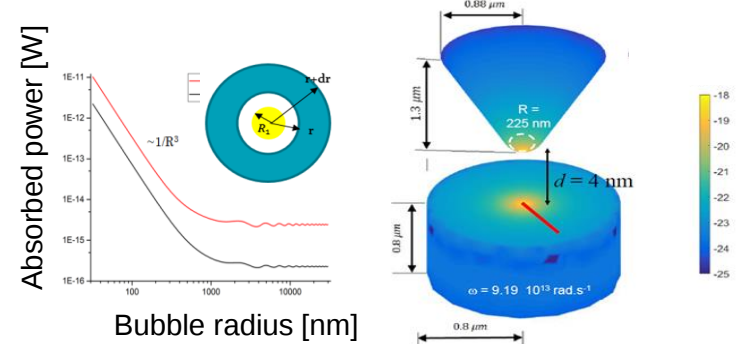
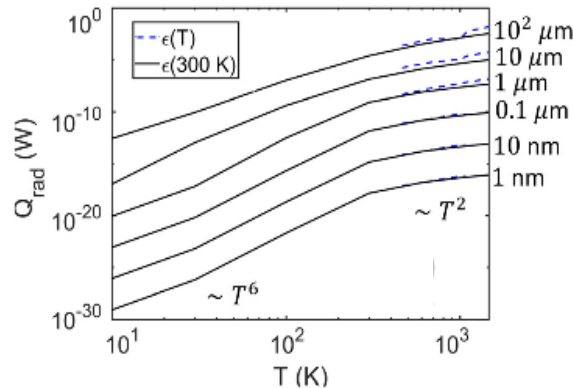
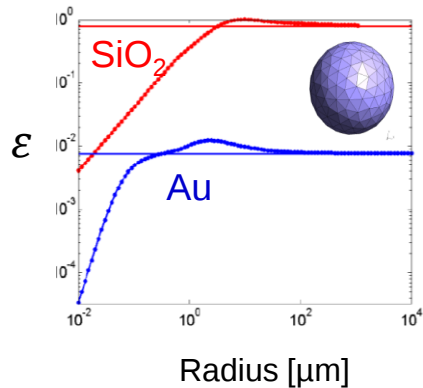


Multiscale: Coupling BTE/FEM

NMTE 24, 150 (2020)
JAP 120, 120, 044305 (2016)

Thermal radiation: from fundamentals to thermophotovoltaics

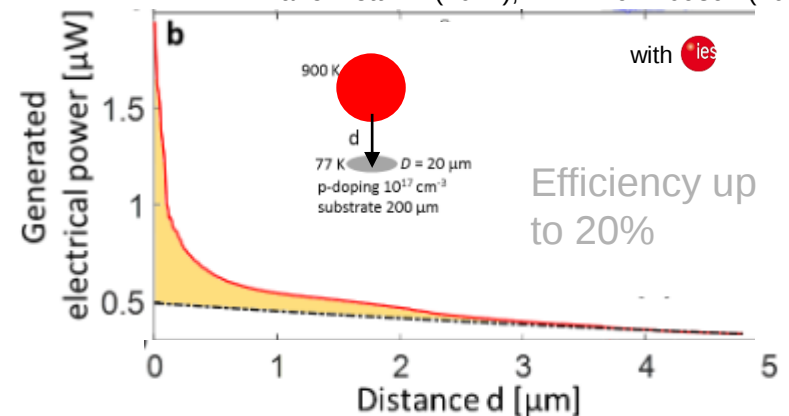
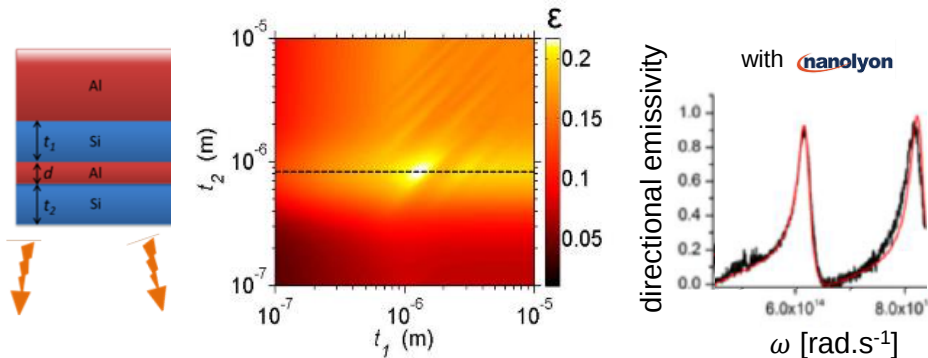
Thermal radiation: towards arbitrary size, interbody distance and shape



APL 112, 111906 (2018); JQSRT 202, 154 (2017)

Thermophotovoltaics/thermophotonics: from design to experiment

Nano. Lett. 21 (2021); ArXiv:1912.09394 (2019)

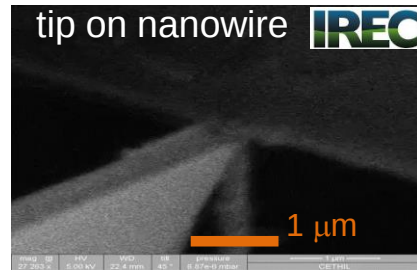
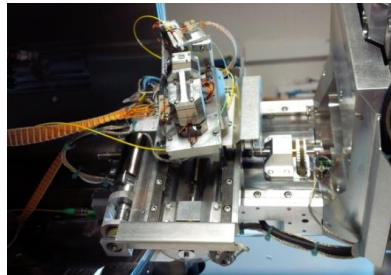


- Thin-film metallodielectric approaches

- Emitters up to 1200 K

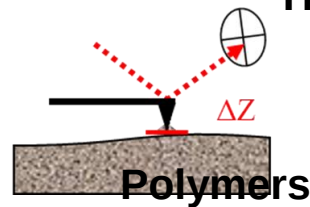
Thermal nanometrology with electro-thermal means

Scanning thermal microscopy: tools

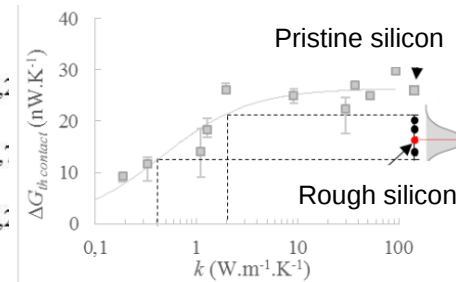
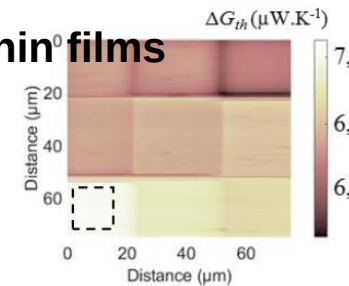


SThM in SEM

- AFM-based experiments: nm to μm
- Thermal conductances: nW.K^{-1} to $\mu\text{W.K}^{-1}$
- Thermal conductivity: up to $5 \text{ W.m}^{-1}.\text{K}^{-1}$ (bulks)

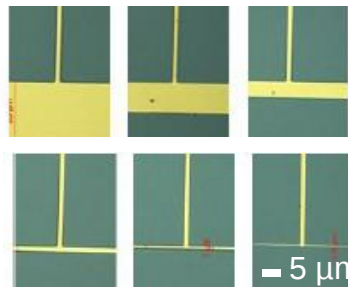
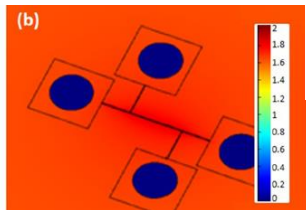


Thin films



JAP 128, 235301 (2020)
IJTS 156, 106502 (2020)
APL 111, 063106 (2017)

Deposited electro-thermal devices



- Temperature dependence: from $\sim 7 \text{ K}$ to room temperature
- Thermal boundary conductances: up to $>100 \text{ MW.m}^{-2}.\text{K}^{-1}$

IEEE CPMT 11 (2021)
AIIP Adv. 8, 045111 (2018)



<http://cethil.insa-lyon.fr>