



leti
cea tech

CEA-Leti: La ricerca tecnologica applicata alle nanotecnologie

PUBLIC RESEARCH LAB IN ELECTRONICS AND INFORMATION TECHNOLOGIES

Narciso Gambacorti

CEATech is a division of the French **CEA** (Commission for Nuclear and Alternative Energies)

4 divisions :

16 000 employees

10 % PhD and Post-doc students

10 research centers all over France



Nuclear Energy

Defense and Security

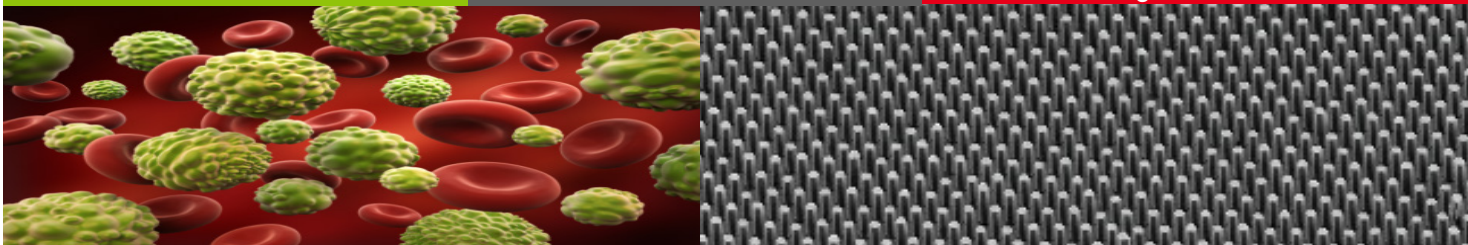
Technological Research

leti Electronics and Information Technologies

liten New Energy Sources

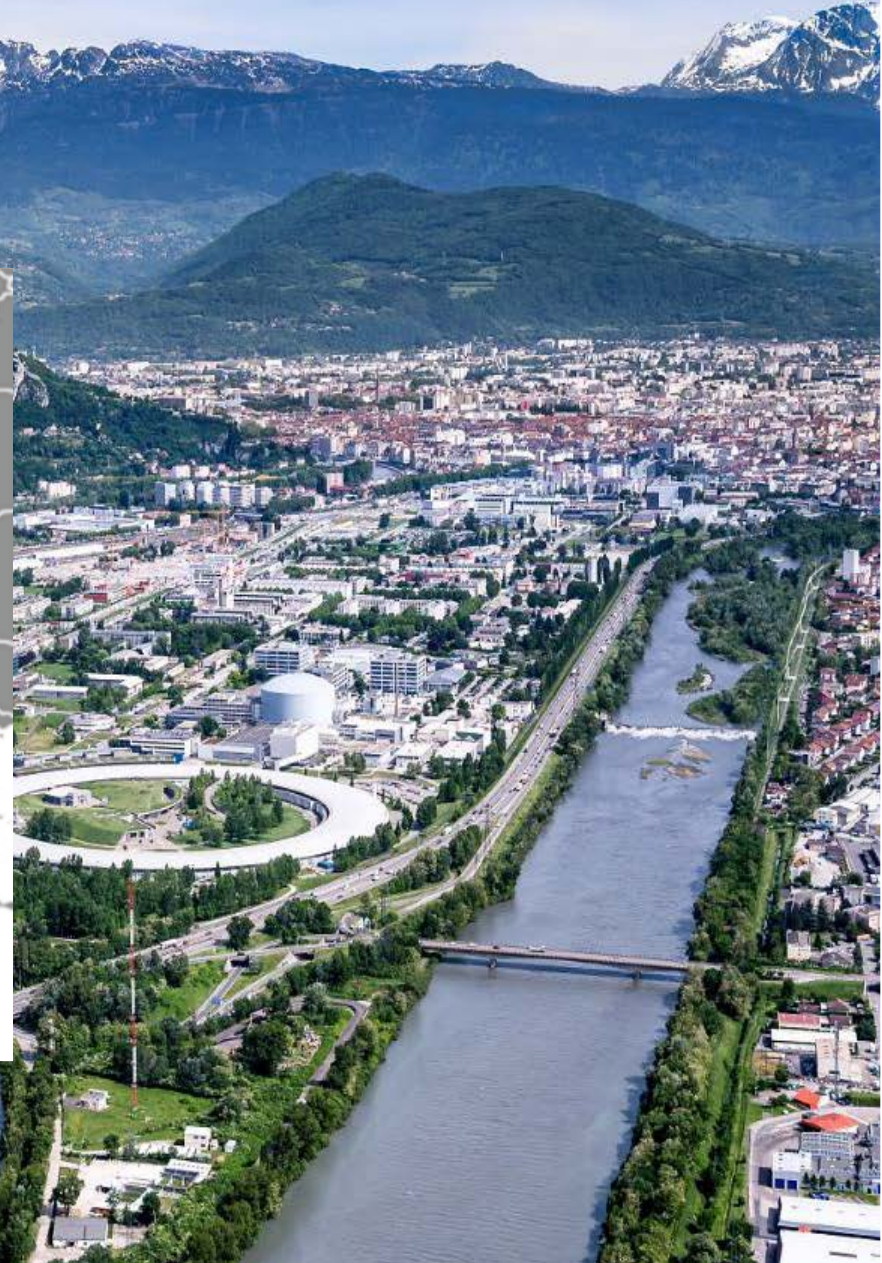
list Data, SW and Robotics

PRTT Regional Platforms



Fundamental Research (Life and Material Sciences)

GRENOBLE – A DYNAMIC INNOVATION ECOSYSTEM



GRENOBLE – A DYNAMIC INNOVATION ECOSYSTEM

- **GRENOBLE: HIGH TECH INDUSTRY – FRANCE'S SILICON VALLEY**
- **CONCENTRATION OF KNOWLEDGE AND SKILLS: MNT FOR ICT, ENERGY, HEALTH**
- **STRONG HISTORICAL COLLABORATION : INDUSTRY, R&D AND ACADEMIA**
- **IMPORTANT S & T RESEARCH INFRASTRUCTURES**
- **TECH TRANSFER AND START-UP CULTURE**
- **INTERNATIONAL SCIENTIFIC MOBILITY**

LETI IN NUMBERS

1800 skilled employees

- **1200** permanent researchers
- **260** PhD students, **40** Post-docs
- **37%** foreign students, **40** nationalities

8,000 m²
of clean rooms

- **300 mm** CMOS
- **200 mm** CMOS & MEMS/NEMS
- Operated 24/7

320 M€

Budget

700 publications/year

in peer reviewed journals

365 industrial partners

61 start-ups by end 2016

Academic and
RTO partners

2800 patent families

- **300** deposited in 2016
- **40%** licenced to industry

MINATEC: RESEARCH + EDUCATION + INDUSTRY COMMON LABS AND PLATFORMS



leti
cea tech

Grenoble INP
phelma

CIME
nanotech
pôle
CNFM
de Grenoble

IMEP-LAHC

Inria

INAC
INSTITUT NANOSCIENCES
ET CRYOGÉNIE

spintec
SPIN IN ELECTRONICS

LTM
LABORATOIRE DES
TECHNOLOGIES DE LA
MICROÉLECTRONIQUE

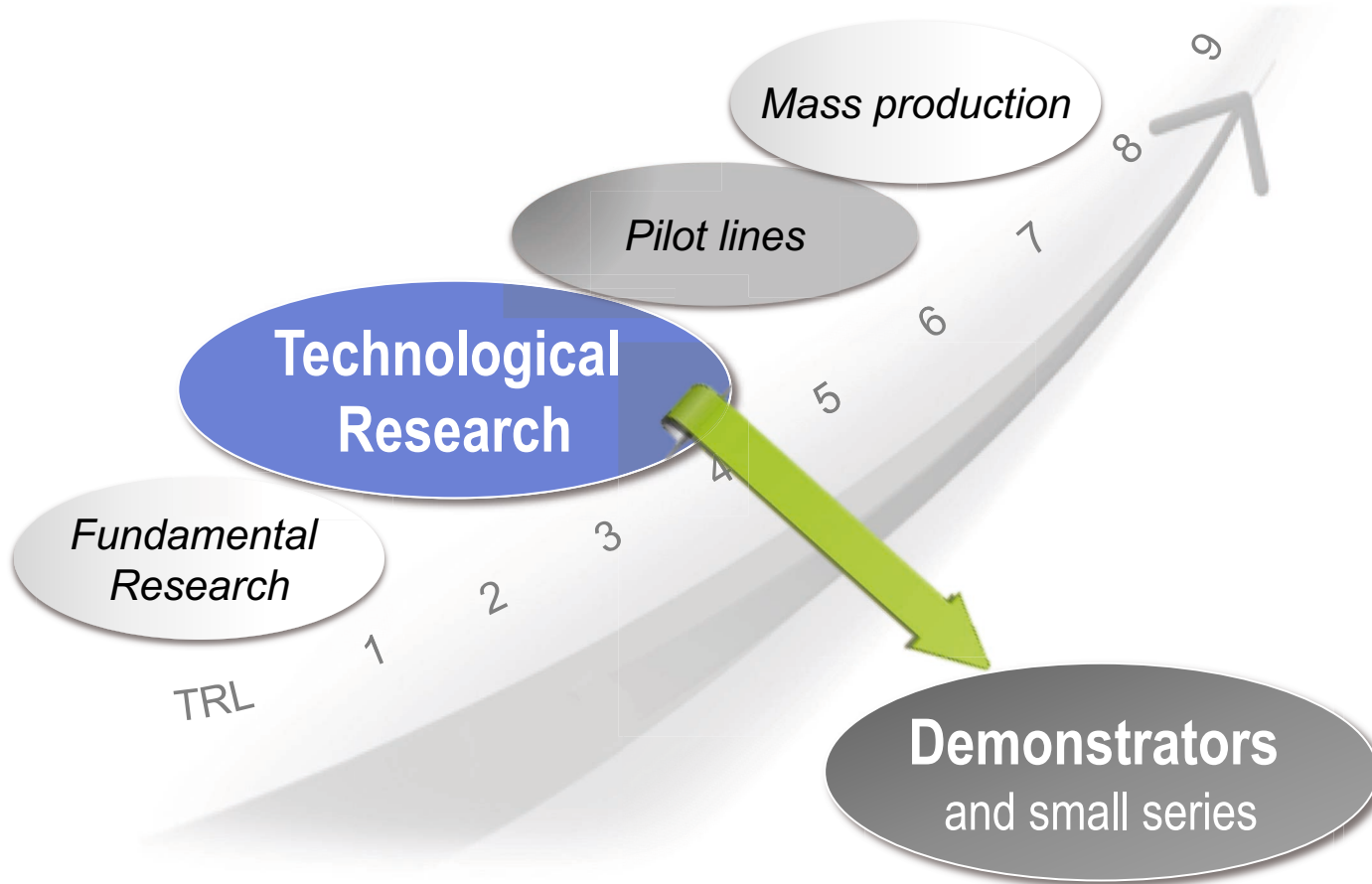
cea

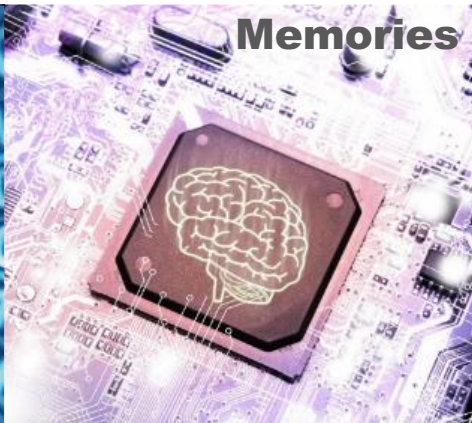
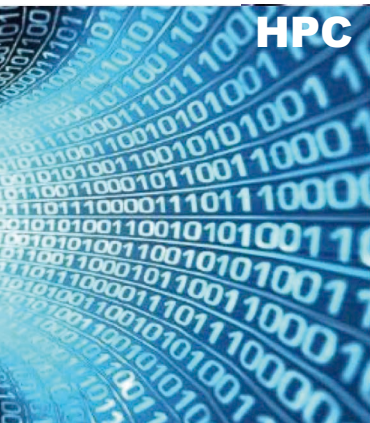
cnrs

UNIVERSITÉ
Grenoble
Alpes

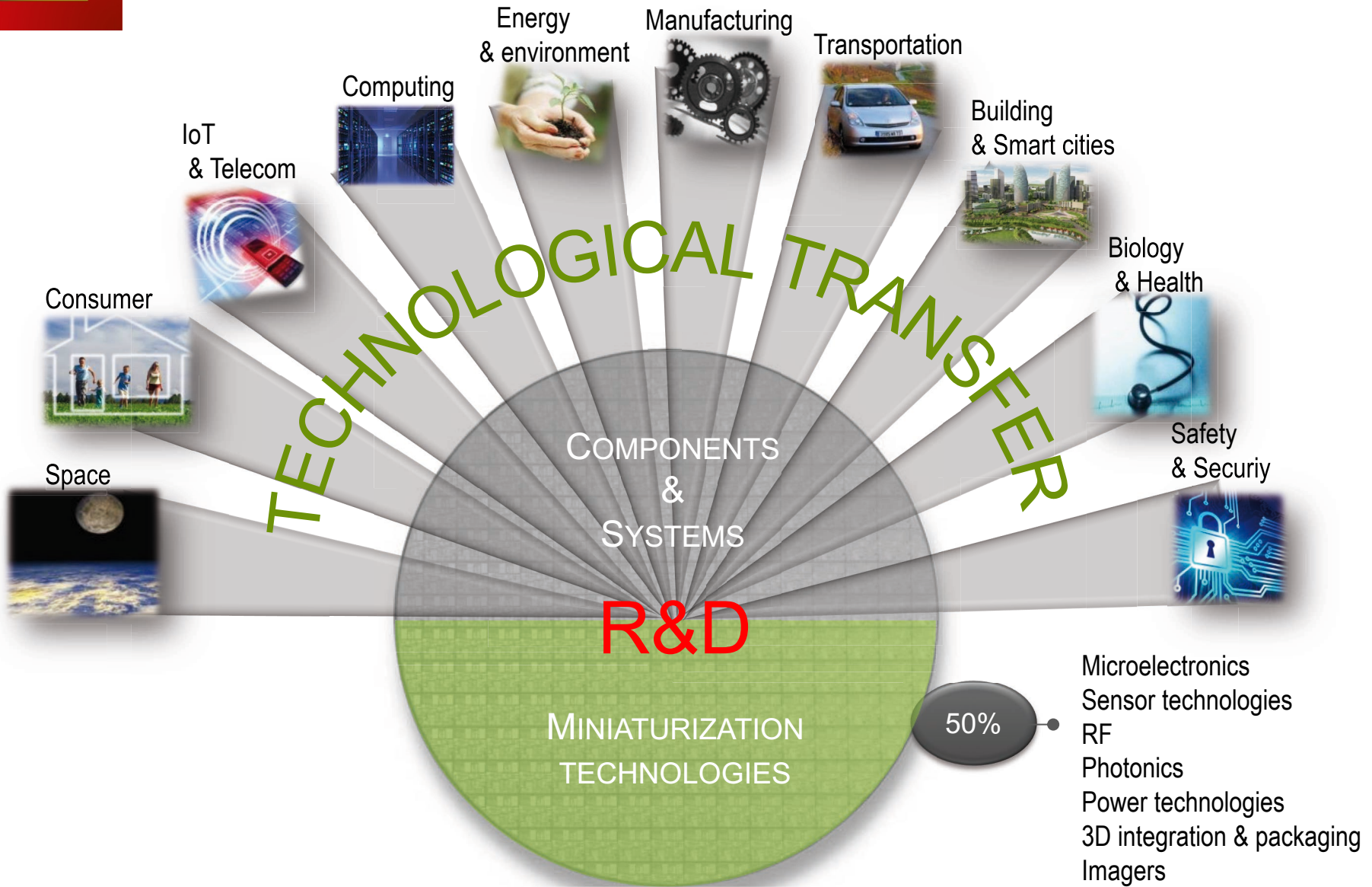
LETI'S MISSION

**Create and accelerate
innovation with and for industry**





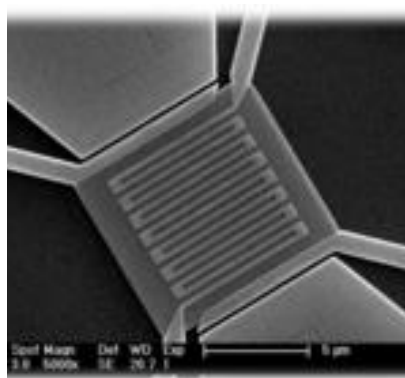
FIELDS OF ACTIVITY IN A CONNECTED WORLD



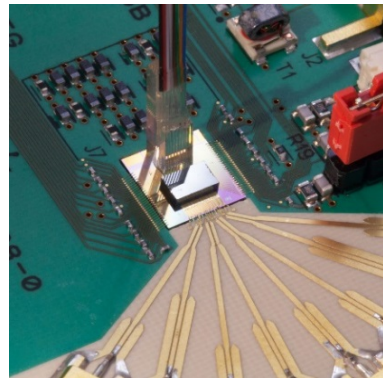
Information and Communication Technologies



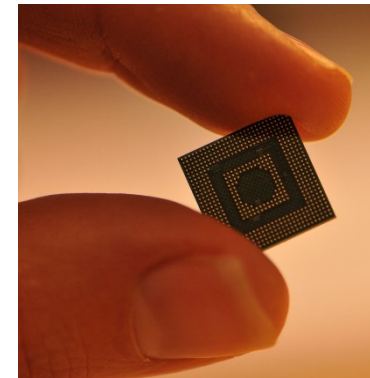
NANOELECTRONICS (300MM)



**MICROSYSTEMS &
SENSORS (200MM)**



PHOTONICS

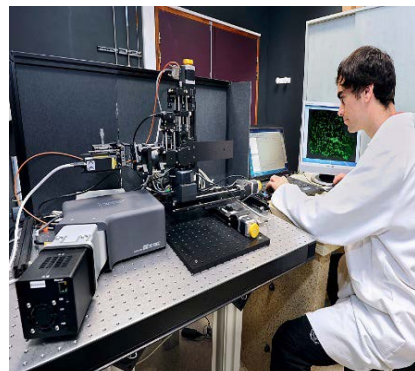


**IC & EMBEDDED
SYSTEMS DESIGN**

Health

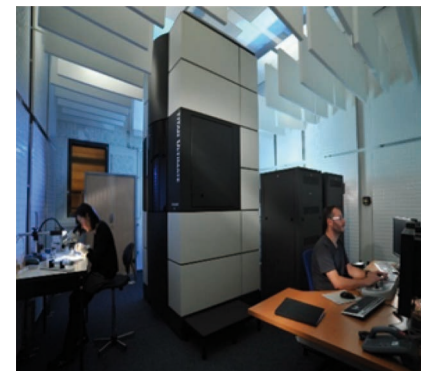


CLINATEC



NANOBIOTECHNOLOGY

Characterization

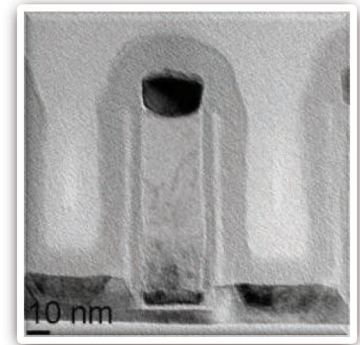
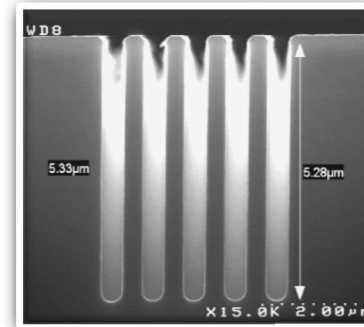


NANOCHARACTERIZATION

KEY ACTIVITIES IN MINIATURIZATION

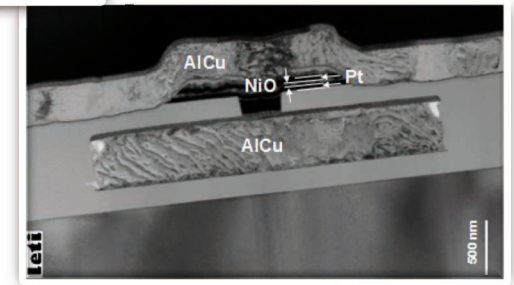
CMOS (300mm)

- Focus on FDSOI for sub 28nm TN (speed and power consumption)
- Si nanowire for 10 nm TN
- 3D stacked devices



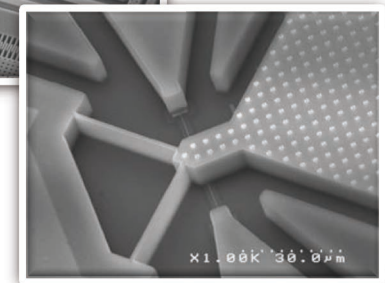
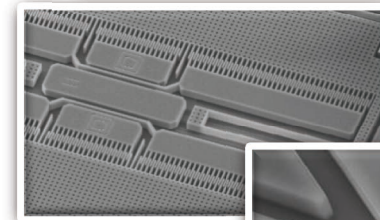
3D Integration (300mm)

- Si interposer
- High density TSV, TSV Mid/Last etc..



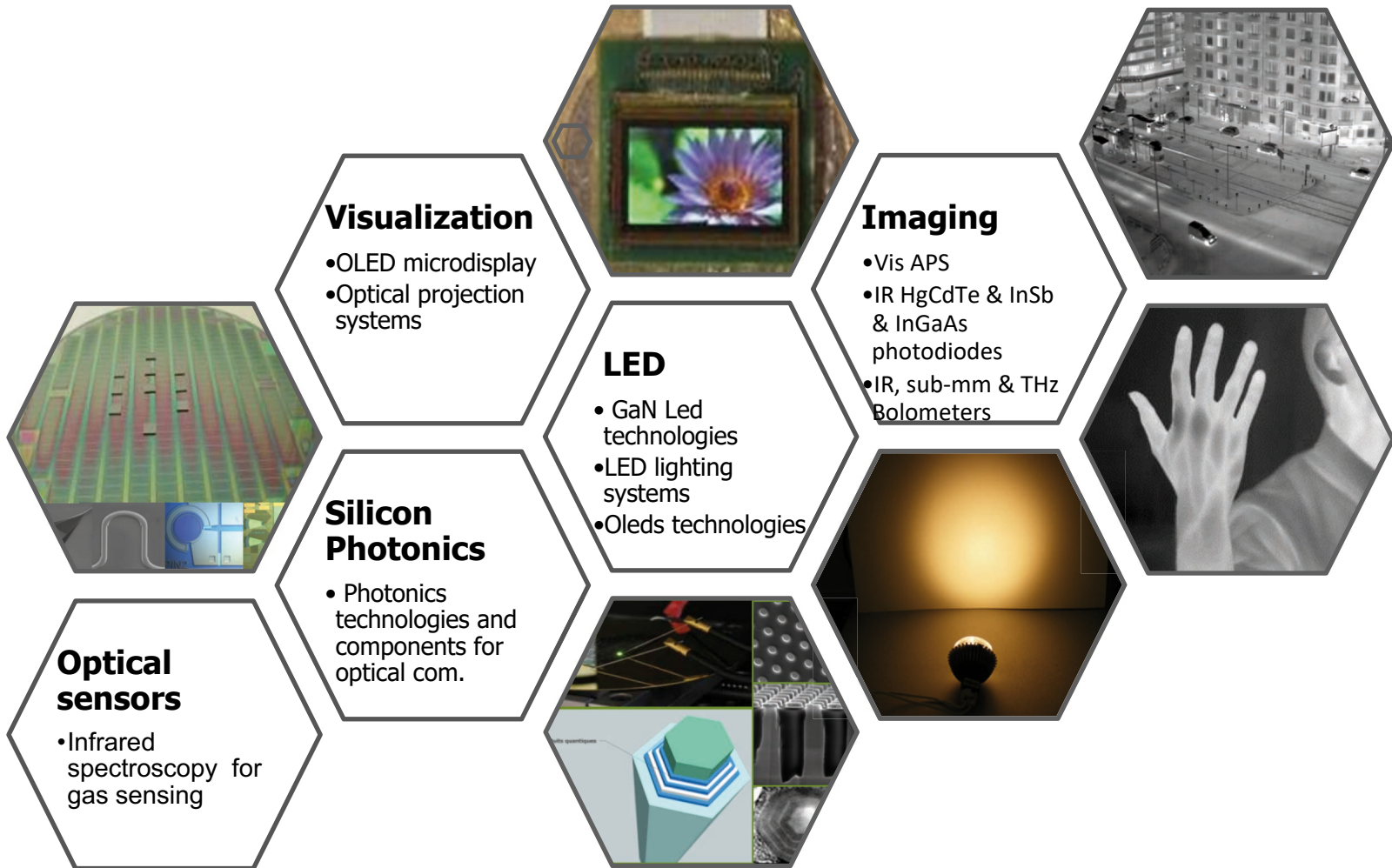
Memories (200mm)

- Embedded non volatile memories
- Focus on resistive memories (PCM, CBRAM, OXRAM and MRAM) for speed, consumption, reliability



Microsystems and Advanced components (200mm)

- MEMS, NEMS, actuator, RF components, Power devices





Therapy



**Diagnostic
& monitoring**



Imaging



Sports & Well being



**Technological
components**



**New validated
medical functions**



**Complete system design
and integration**

PARTNERING EXAMPLES

Information and Communication

SOI wafers 



1. Initial silicon
2. Oxidation
3. Implantation
4. Cleaning and bonding
5. Splitting
6. Annealing and CMP touch polishing


SOI wafer


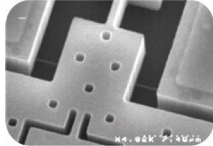
FDSOI Transistors 
life.augmented




eQuad

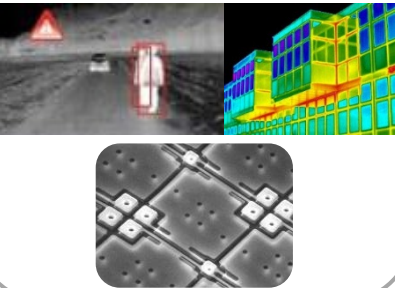
Poly 5.0 nm
Refined SiD 40 nm
Substrate 10 nm
Thin Si film

Sensors 

Security

IR Imagers 
Infrared for you



Health

Biotech 



Energy

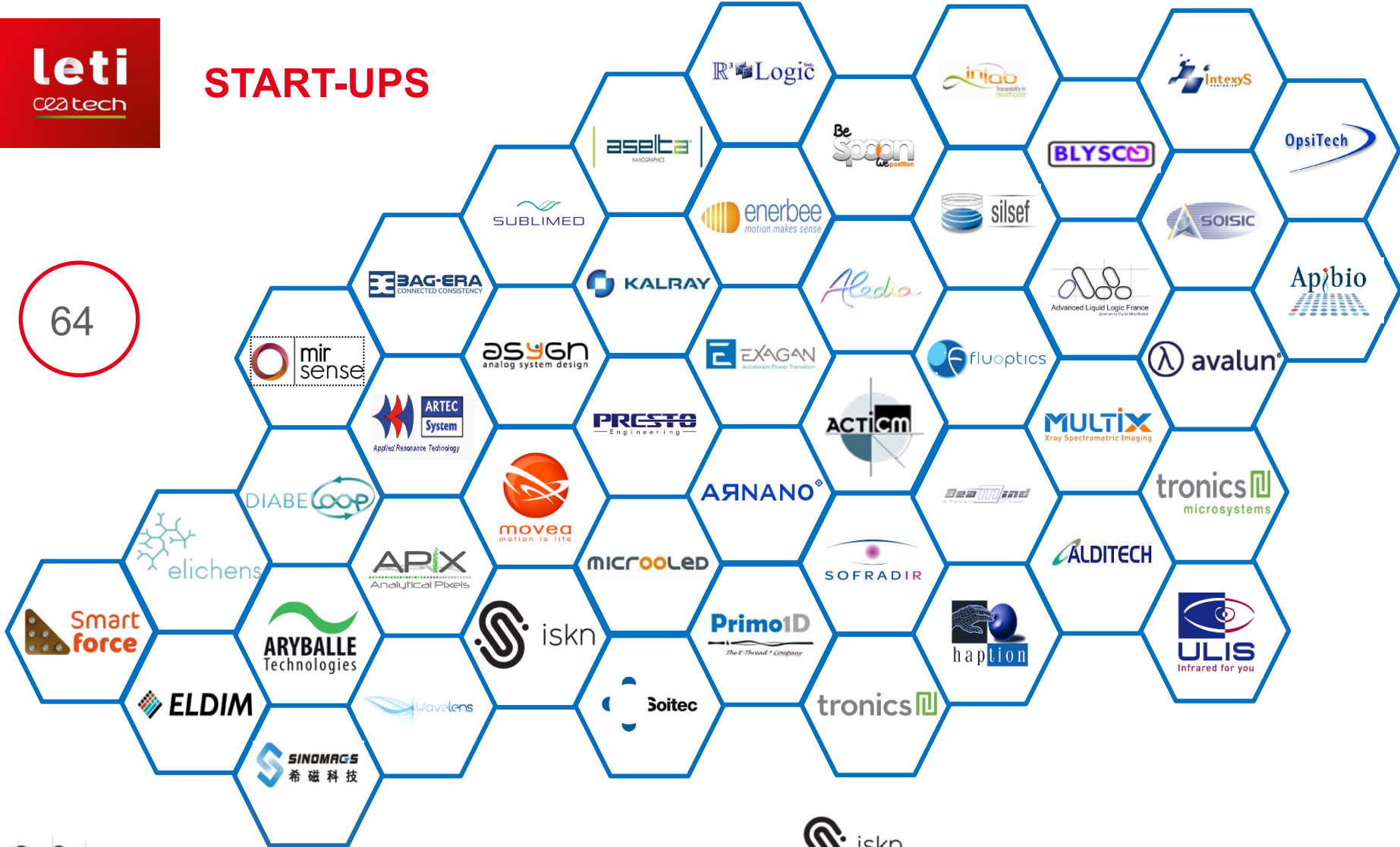
LEDs 





START-UPS

64

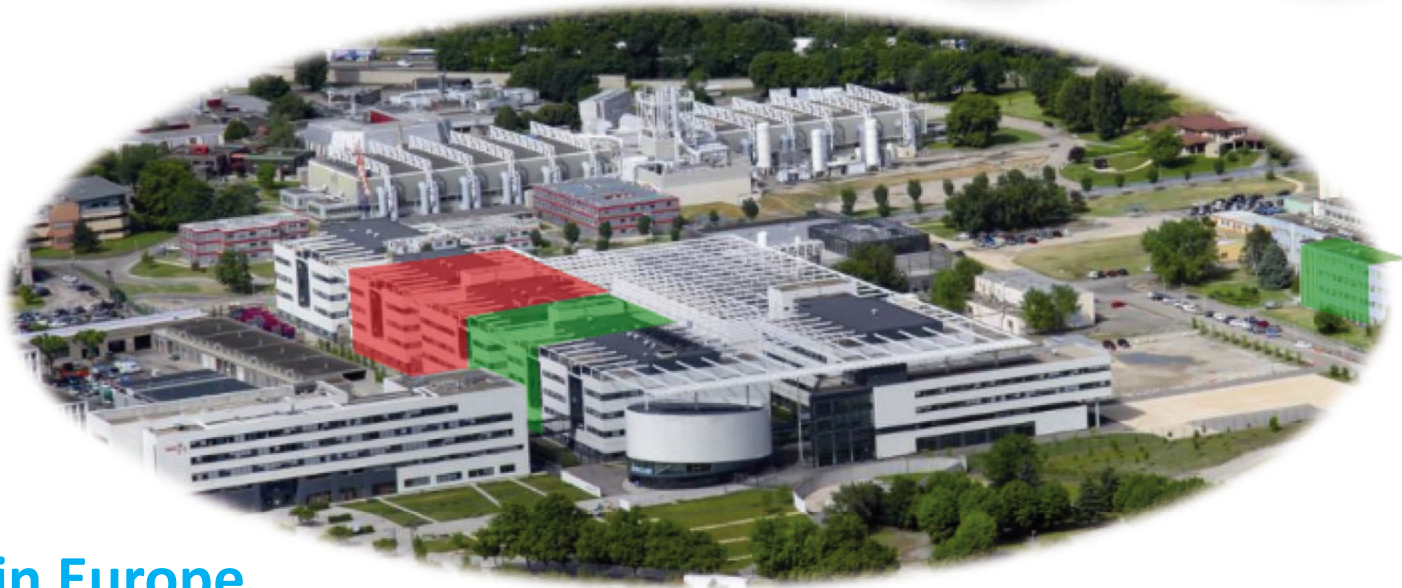


Timeline of startups from 2011 to 2016:

- 2011:** Advanced Liquid Logic France (powered by Digital Microfluidics), APiX Analytical Pixels
- 2012:** WAVELENS, APiX Analytical Pixels
- 2013:** PrimoID The E-Thread Company, iskn
- 2014:** ARYBALLE Technologies, iskn
- 2015:** enerbee motion makes sense, mir sense, BLYSCO
- 2016:** elichens, BAG-ERA CONNECTED CONSISTENCY, SUBLIMED

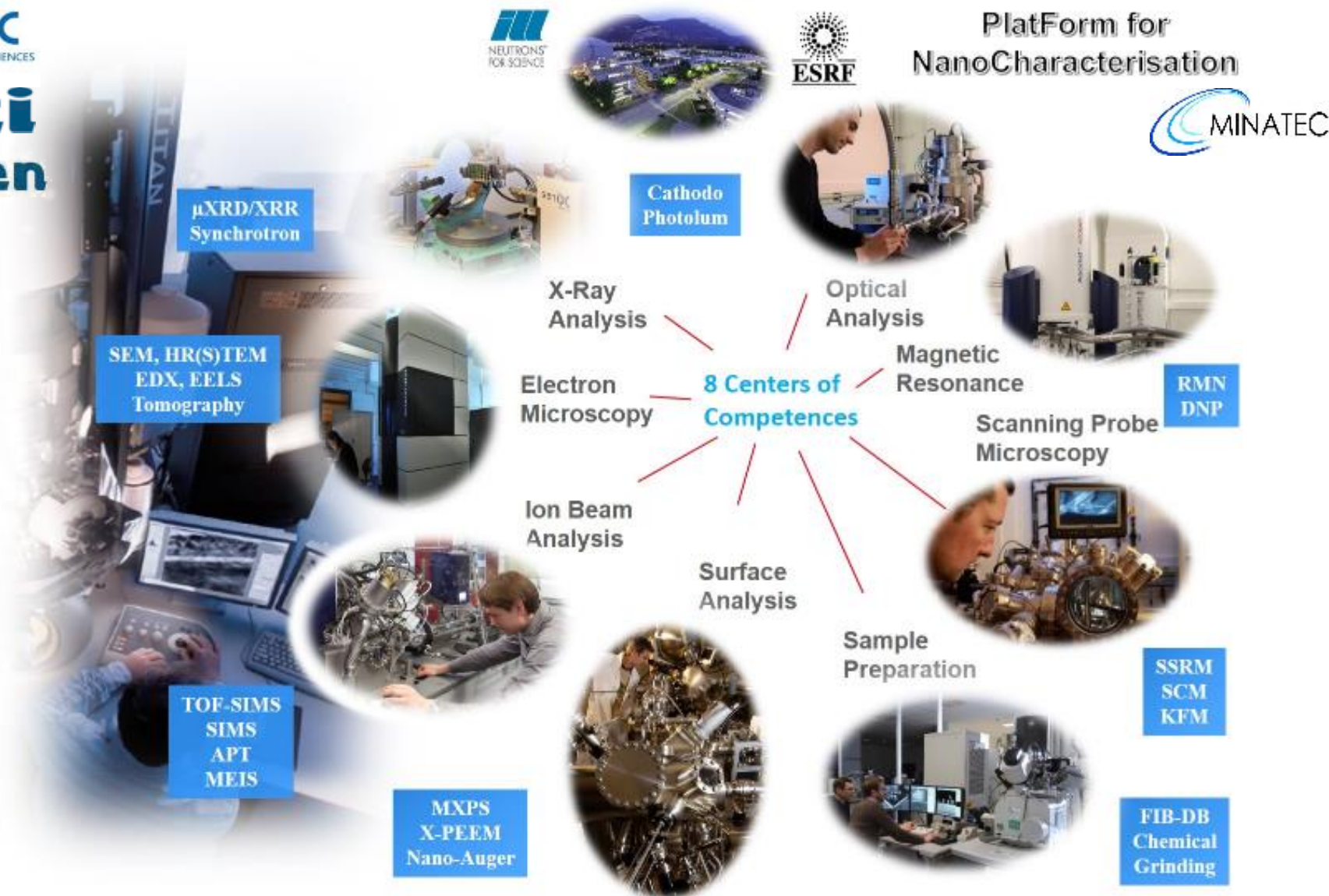
PFNC... at a glance

~**100** Researchers and Technicians,
50 Advanced characterisation tools,
3500m² of laboratories,
2 M€ of investments per year,
1 partnership with SERMA Tech.
Access to Large Research Facilities

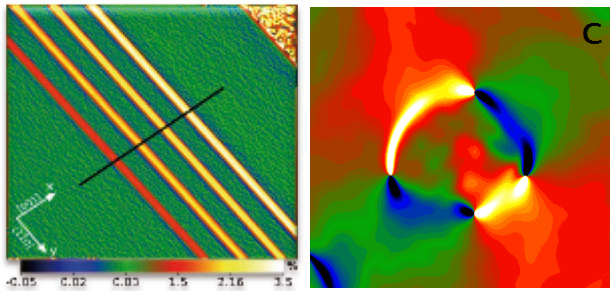


Unique in Europe

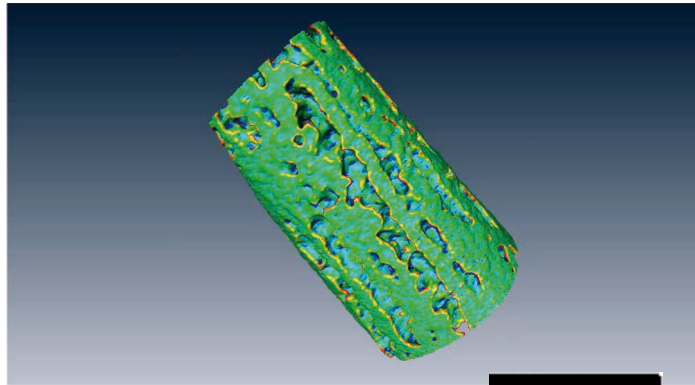
PFNC : Complementary techniques



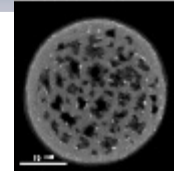
Tool Box of TEM Methodologies



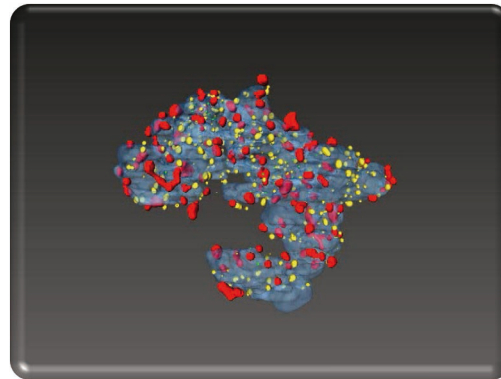
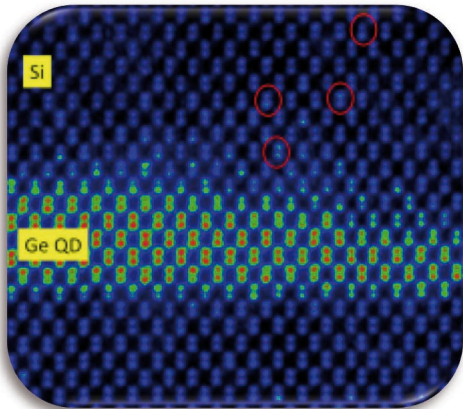
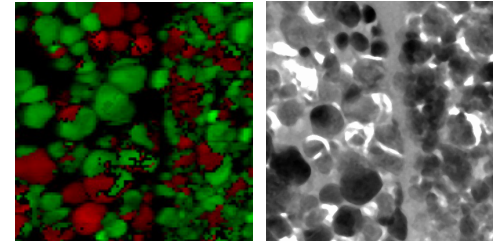
Strain mapping
HRTEM, CBED, NBED,
Holography (dark)



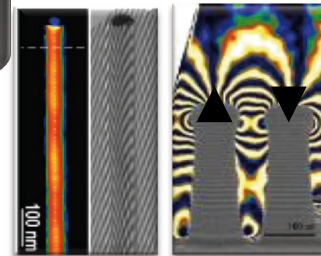
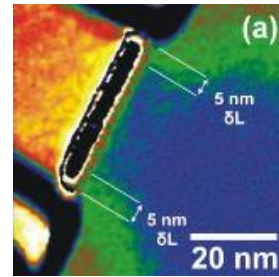
E-Tomography on porous Si
nanowire with Erbium
inclusions (phi 100 nm)



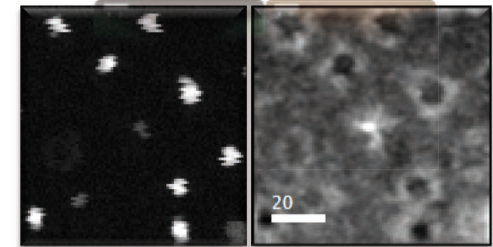
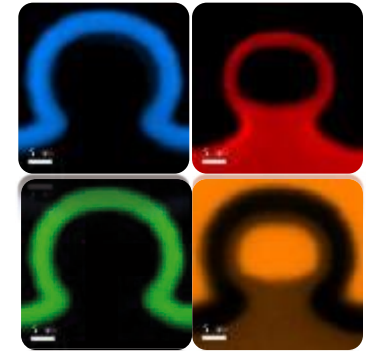
Phases determination/mapping



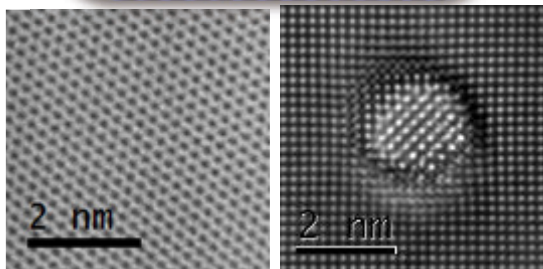
e- Tomography



Electric & Magnetic field mapping
Holography & Lorentz



Chemical Information
(EELS, EFTEM, EDX)



Atomic imaging HRSTEM, HRTEM

Thank you for your attention



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Commissariat à l'énergie atomique et aux énergies alternatives

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