

CNR-ISMN: materials, technologies and infrastructures - a framework for collaboration

Vittorio Morandi

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Scientific Excellence

- **55 Active Projects** – European (27%), International (5%), National (62%), and Regional (6%) projects @ Bologna (49%), Palermo + Messina (34%) and Montelibretti (13%) units;
- **Increased projects' capability** – from 37 to 58 submitted projects from 2020 to 2022 respectively;
- **Research productivity** – about 160 papers / years on peer-reviewed international journals, 15% on top-journals (IF > 8);
- **100 Top Italian Scientists in Materials & Nano Sciences** – two researchers of ISMN (M. Cavallini, M. Muccini) in the ranking.



Sections & People

HQ Roma Montelibretti

Staff: 23

Roma Sapienza

Staff: 13

Bologna

Staff: **87**

Palermo

Staff: 27

URT Messina

Staff: 5

Total Staff: 155

Short Term Staff: c.ca 40

Multidisciplinary research on materials and enabling processes and technologies


IMM BOLOGNA UNIT
 Consiglio Nazionale delle Ricerche

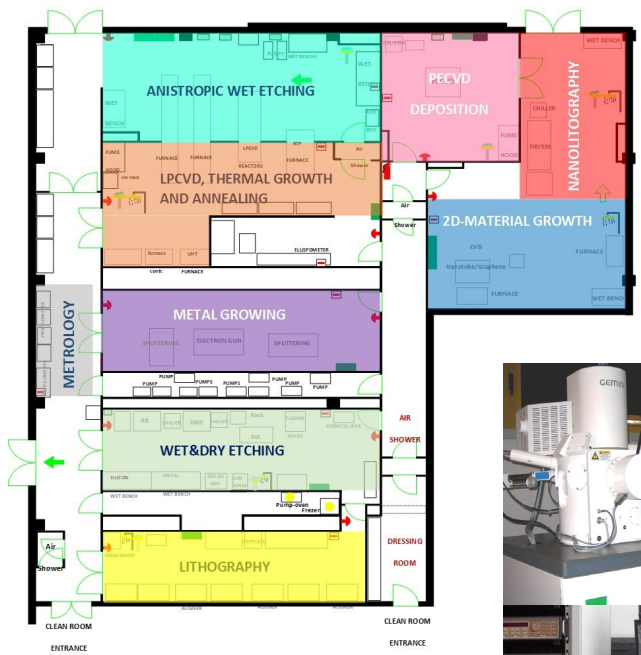
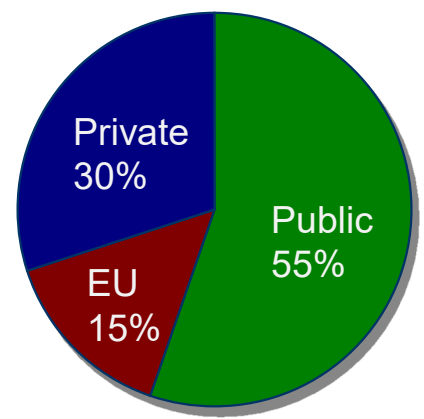



CNRISMN
 Istituto per lo Studio dei Materiali Nanostrutturati

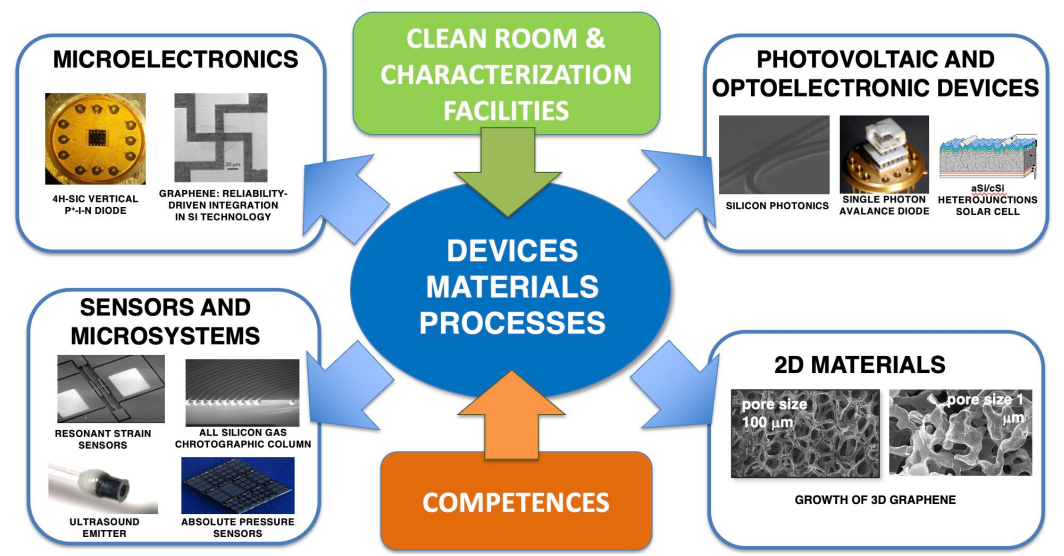
Total Staff **68**

 Permanent Staff 41
 Short Term Staff 15
 Associated Staff 7
 Students 5

Distribution of external annual funding (yearly average on last 3 years - c.ca 1.5 M€/year) without PNRR



500 m² (250 m² class 100) MEMS and CMOS Clean-Room



Structural Characterization: Electron Microscopy and X-Ray Diffraction

Research Infrastructures


iENTRANCE


It-fab
 Italian Network for Micro and Nano Fabrication


EUROnanoLAB


e-DREAM
 EUROPEAN DISTRIBUTED RESEARCH INFRASTRUCTURE FOR ADVANCED ELECTRON MICROSCOPY


RIANA

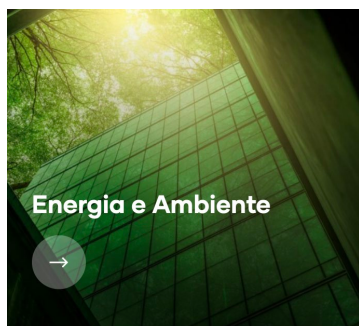

nffa.eu | PILOT


nffa-di
 Piano Nazionale di Ripresa e Resilienza

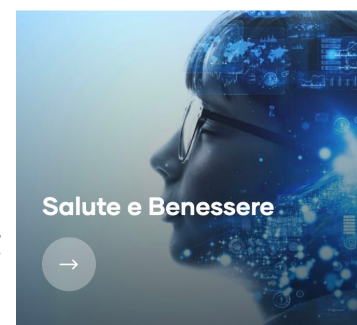
Research Activities



Materials and Technologies for Sustainability - Study and characterize new materials and device development for electronics, bioelectronics, photonics and catalysis;



Energy and Environment - Development of new materials and processes aimed at developing new solutions and technologies for clean energy generation and environmental conservation;



Health and Wellness - Molecular and biological materials and advanced devices for diagnostics, prevention and treatment;



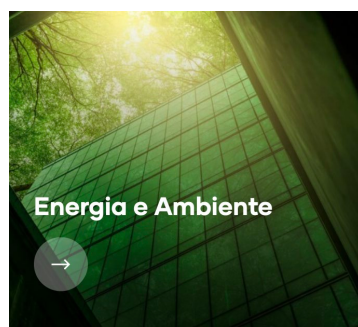
Circular Economy and Industry 5.0 - Development of new materials, devices and technologies, obtained from natural compounds or waste from industrial and agricultural activities.

Multidisciplinary research on materials and enabling processes and technologies

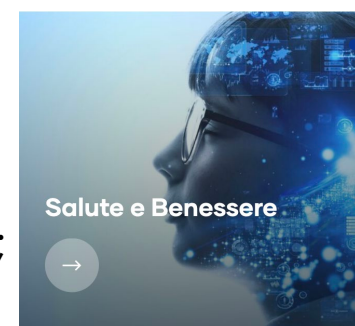
Research Activities



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CNR

Dipartimento Scienze Chimiche e Tecnologie dei Materiali



Research Activities



Materiali e Tecnologie for Sustainability - Study and characterize new materials and device development for electronics, bioelectronics, photonics and catalysis;



Energy and Environment - Development of new materials and processes aimed at developing new solutions and technologies for clean energy generation and environmental conservation;

- *ORGANIC MATERIALS: POLYMERS, SMALL MOLECULES, BIOMATERIALS*
- *INORGANIC MATERIALS: METAL NANOPARTICLES, MAGNETIC MATERIALS, OXIDES, PEROVSKITES*
- *HYBRID MATERIALS: ORGANIC-INORGANIC INTERFACES*
- *FUNCTIONAL THIN FILMS*
- *MATERIALS INTEGRATION IN DEVICES: OPTOELECTRONIC & PHOTONIC DEVICES, ORGANIC TRANSISTORS, SENSORS, CATHALYTIC ELECTRODES*

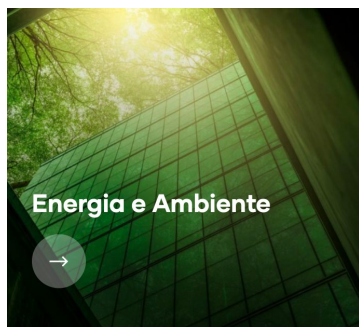
CNR

Dipartimento Scienze Chimiche e Tecnologie dei Materiali

Research Activities



- **Materials and Technologies for Sustainability** - Study and characterize new materials and device development for electronics, bioelectronics, photonics and catalysis;



Energy and Environment -

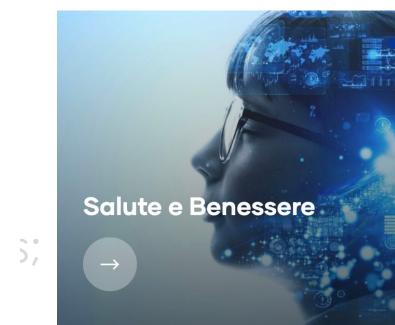
Development of new materials and processes aimed at developing new solutions and technologies for clean energy generation and environmental conservation;

- *ELECTROCHEMICAL ENERGY CONVERSION AND STORAGE BASED ON NATURAL AND WASTE MATERIALS*
- *NEW GENERATION LITHIUM BATTERIES, DEVELOPMENT OF GREEN AND NEW BATTERIES TECHNOLOGIES*
- *CO₂ VALORIZATION INTO HIGH ADDED VALUE PRODUCTS*
- *CATALYTIC MATERIALS AND PROCESSES FOR THE REDUCTION OF EMISSIONS FROM COMBUSTION ENGINES AND ABATMENT OF POLLUTANTS IN AIR AND WATER*
- *PHOTOVOLTAIC MATERIALS AND TECHNOLOGIES: ORGANICS (OPV), PEROVSKITE (PSC), DYE (DSSC). NATURAL & SUSTAINABLE MATERIALS & PROCESSES*

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Research Activities

- SYNTHESIS OF CHEMICAL AND BIOLOGICAL MATERIALS AND INTEGRATION IN ADVANCED BIOMEDICAL SYSTEMS
- NOVEL SOLUTIONS FOR SENSING AND MONITORING OF ENVIRONMENTAL POLLUTION (CHEMICAL AND MICROBIOLOGICAL POLLUTANTS)
- INVESTIGATION AND MODULATION OF INTRACELLULAR AND INTERCELLULAR COMMUNICATION MECHANISMS (NEURONAL CELLS)
- ENGINEERING AND MODULATION OF CELL-MATERIAL INTERFACES
- TRANSPORT AND DELIVERY OF ACTIVE MOLECULES AND DRUGS



Health and Wellness - Molecular and biological materials and advanced devices for diagnostics, prevention and treatment;



Circular Economy and Industry 5.0 - Development of new materials, devices and technologies, obtained from natural compounds or waste from industrial and agricultural activities.



Research Activities

- Materials and Technologies for Sustainability** - Study and characterize new materials and devices

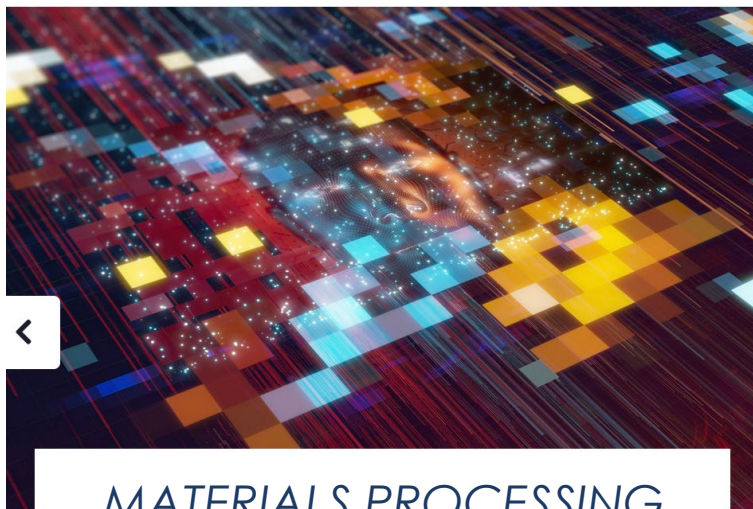
- *DEVELOPMENT OF NOVEL SUSTAINABLE FUNCTIONAL MATERIALS*
- *INNOVATIVE AND SUSTAINABLE DEVICES AND TECHNOLOGIES BASED ON NATURAL COMPOUNDS OR INDUSTRIAL AND AGRICULTURAL WASTES*
- *VALORIZATION OF FOOD WASTES, AGRICULTURAL WASTES, BIOMASSES, FISHING WASTES, MINE WASTES*
- *USE & INTEGRATION OF DIGITAL AND AI APPROACHES INTO INDUSTRIAL PROCESSES*

- Health and Wellness** - Molecular and biological materials and advanced devices for diagnostics, prevention and treatment;



- Circular Economy and Industry 5.0** - Development of new materials, devices and technologies, obtained from natural compounds or waste from industrial and agricultural activities.

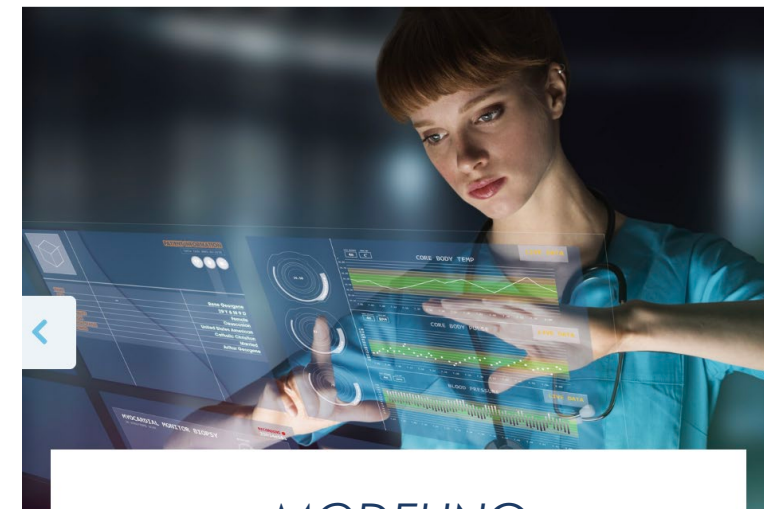
Research and Technological Infrastructures



MATERIALS PROCESSING
&
DEVICE FABRICATION



ADVANCED
CHARACTERIZATION
&
DIAGNOSTICS



MODELING
&
DIGITALIZATION

Data-enabled frameworks

Development and deployment of **dedicated and secure digital frameworks** based on data, fully integrated within the **specific application domain** and use-case



Application to key technologies

Digital and data-driven innovation for hi-tech applications, including **health and wellness, biomedical sector, sustainable and circular economy**, and others

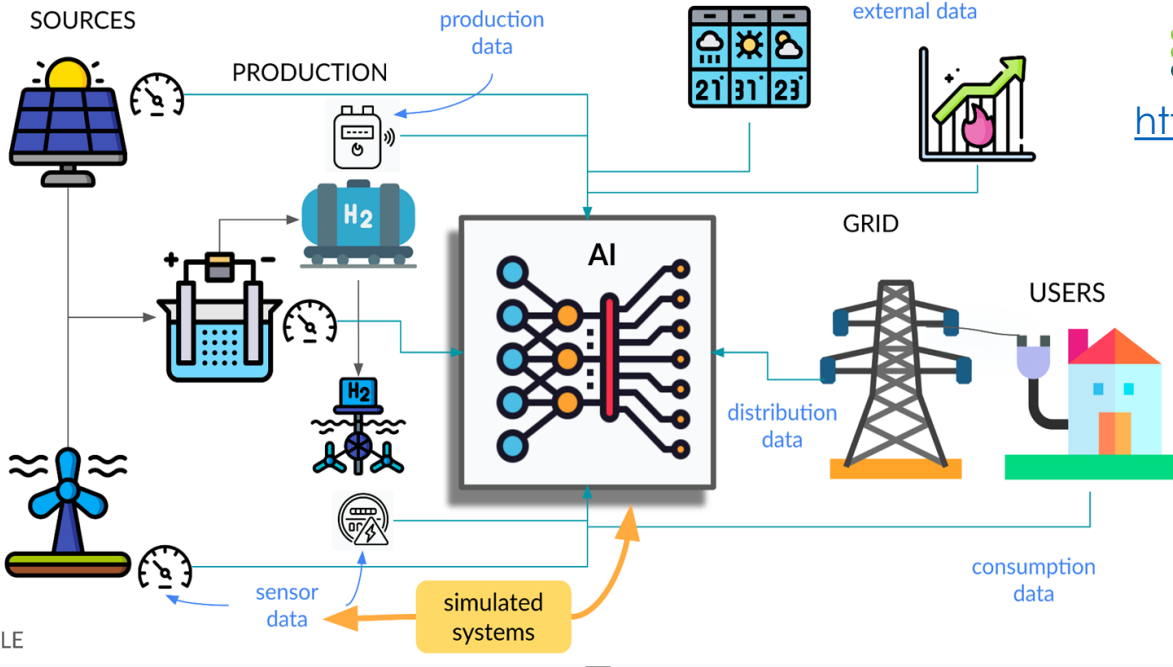


High-performance computing

Specialized **hardware and software infrastructures and technologies**, including high-end cloud and data storage systems, and advanced **software and simulation systems**

Machine learning and AI

Application of **data-driven** approaches, **deep-learning** and artificial neural networks and **big-data** as core technologies to develop predictive models and automated systems




<https://daimoners.eu/>


HE Grant Agreement
No. 101091464


HE Grant Agreement
No. 101137809


Decision science design platform for digital twins

COST Action 2023-2027
No. CA22143

«Decision science design platform for digital twins» MIMIT M4.C2 Accordi per l’Innovazione


AdP POR H2 «Research and development on hydrogen»

Case Study - AI FRAMEWORK FOR THE MANAGEMENT OF H2 GRIDS



CNR | Dipartimento Scienze Chimiche
e Tecnologie dei Materiali

To support and encourage the **joint participation** of institutes in national and international initiatives involving **research**, **highly specialized consulting**, **advanced training**, and **scientific dissemination** in the field of science and technology for the knowledge and preservation of cultural heritage

CNRISMN Montelibretti
Palermo
Istituto per lo Studio dei Materiali Nanostrutturati



Nanotechnologies for Cultural Heritage and Sustainability - **TECLA** and **DELIAS** projects

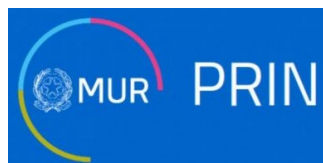


Sustainable materials design and engineering, and diagnostic techniques for restoration and protection



- **8 SPM microscopes** in different environments, from liquid to Ultra-High Vacuum
- **2 servers** for data exchange and automatic backups of instruments
- **1 workstation** for data analysis
- **Teamup webpage** for booking SPMs (SPMs are fully shared and open access)

- PNRR 2022 “**Chiral Coordination Polymers for Energy Applications (CHICOPEA)**”
- PRIN 2022 “**F**unctionalized surfaces by **T**rue molec**U**lar bottom-up g**R**owth (FUTURO)”
- PRIN 2022 “**M**olecular **A**ssisted atom **V**acancies Arrangement to modulate magnetism in 2D transition Metal dichalcogenides” (MAVAM)



H2020 Grant agreement No 952183



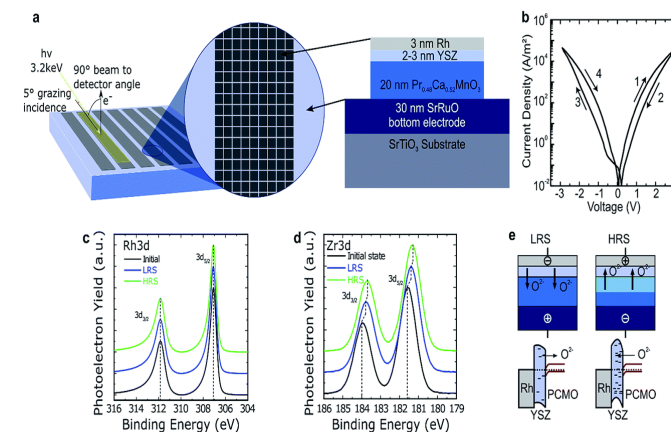
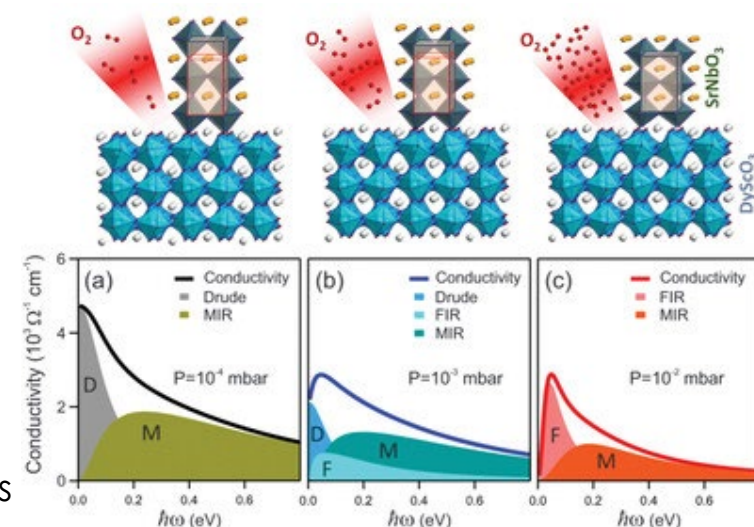
Free-of-charge access to **advanced spectroscopic, scattering and imaging techniques** for *ex-situ*, *in-situ* and *in-operando* investigations.

Materials of interest

@ISMN: Strongly Correlated Oxides, Organic Semiconductors, 2D Transition Metal Dichalcogenides, etc.

Applications:

spintronics, solar cells, resistive switching devices, photocatalysis



- “Tuning Electronic and Functional Properties in Defected MoS2 Films by Surface Patterning of Sulphur Atomic Vacancies”, **Small Methods**, 2401486 (2024)
- “Origin of Magnetism in a Supposedly Nonmagnetic Osmium Oxide”, **Phys. Rev. Lett.** 133, 066501 (2024)

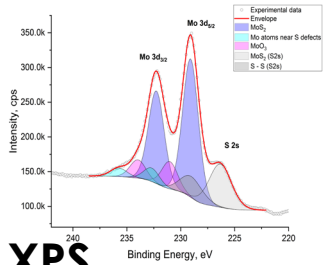


- **ESCALAB MkII**
- **ESCALAB 250 Xi**

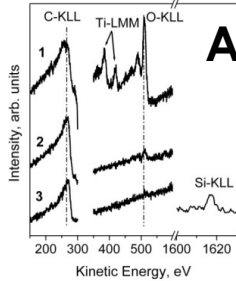
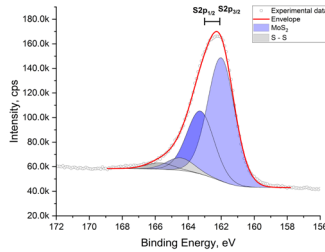
1. X-ray Photoelectron Spectroscopy (XPS)
2. Auger Electron spectroscopy (AES)
3. Ultra-violet Photoelectron Spectroscopy (UPS)

for

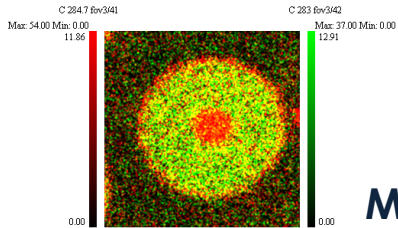
- Film and Thin Film
- Nanomaterials
- Powders
- Metals and Alloys



XPS

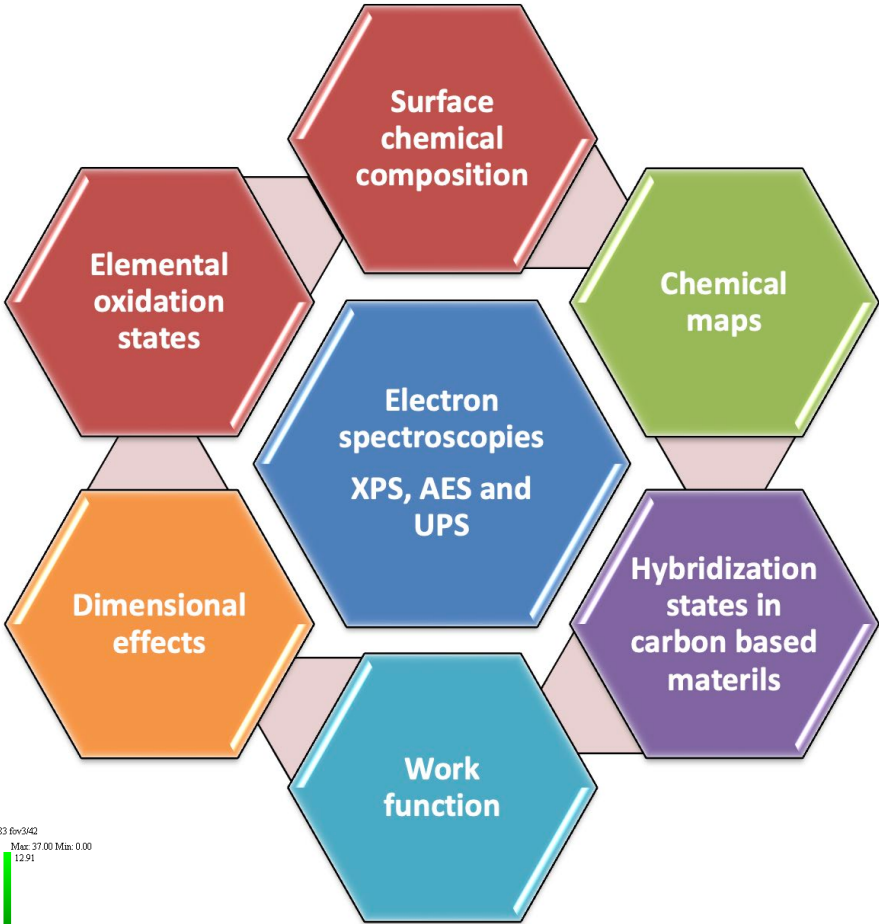


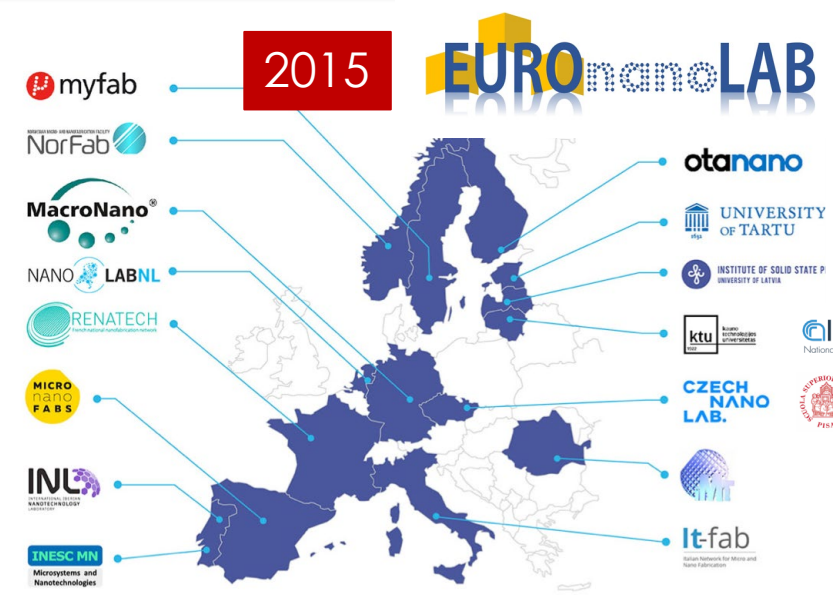
AES



MICROSCOPY

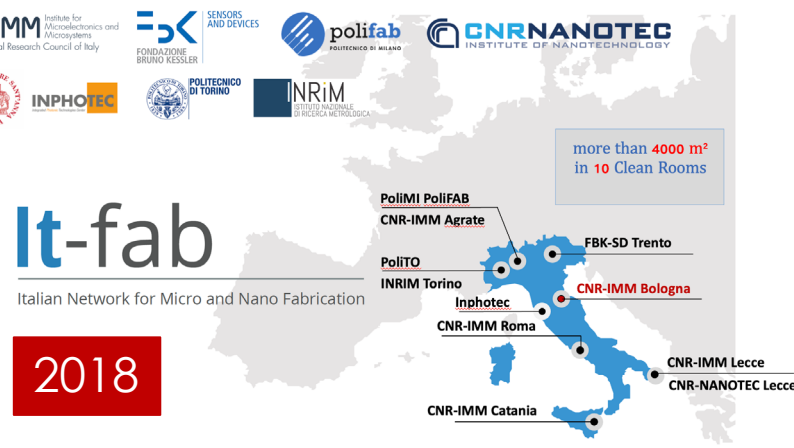
Surface information (< 10 nm)





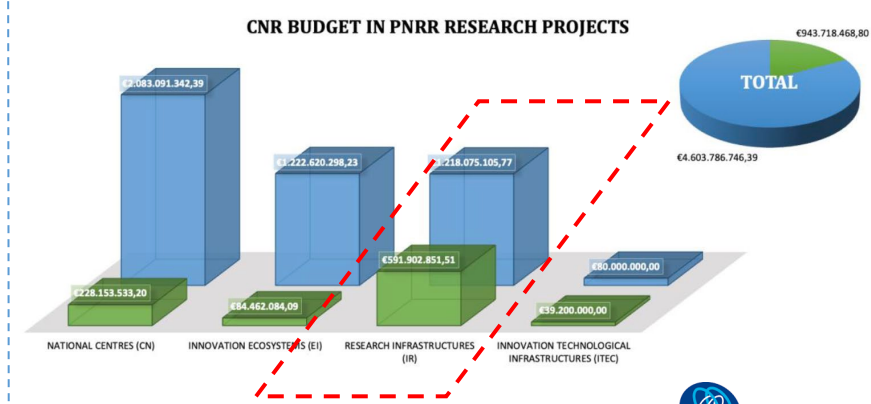
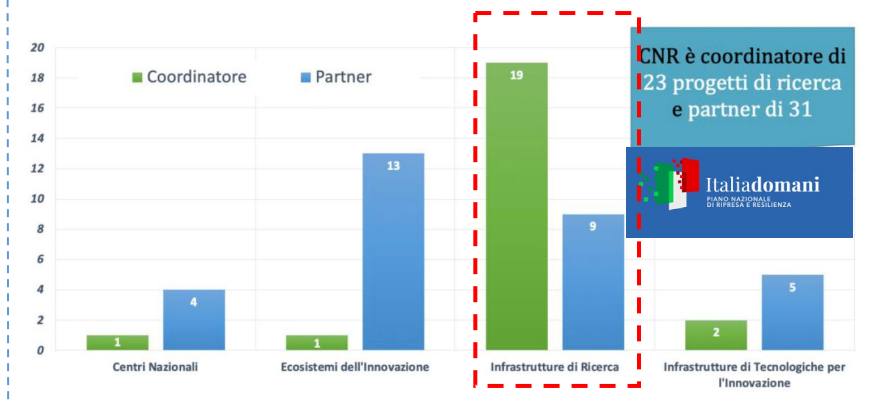
EuroNanoLab comprises 44 Nanolabs in 14 countries with 7 National Networks

Chair: V. Morandi



Promoting the organization at the National level - Establishment of It-fab

Coordinator: V. Morandi



A new Research Infrastructure systems @ PNRR

2022

infrastructure for
ENERgy TRANSition
and **Circular**
Economy @
EuroNanoLab



The “Infrastructure for Energy Transition and Circular Economy @ EuroNanoLab” (iENTRANCE@ENL) will focus its research activities and services on four main topics:

- **Nanomaterials for Energy**
- **Technologies for the realization of devices and systems**
- **Processes for material production and transformation to devices**
- **Micros and nanoscale characterization systems and multiscale experimental techniques**

Overall, the infrastructure will provide **opportunities for research excellence** across materials for green energy, green fuel production, energy storage and energy management



PIANO NAZIONALE PER LA SCIENZA APERTA



FACTS & FIGURES

- Infrastructure: **14 operating units** organized in **6 geographical nodes** recognized in complementary research domains of the initiative
- Time: **2022 - 2025**
- Coordinator: **V. Morandi**
- Total investment: **75 M€**
- Total CNR-ISMN Budget: **12.2 M €**





We are
a **single entry point**
to cutting-edge **materials research**

Read more →

HIGHLIGHTED

The First Call is open

Deadline July 5, 2025

The first call for access to the iENTRANCE research infrastructure is now open. You can find the application procedure in the “Send your project” section, where you can download the submission form and consult the specific guidelines. Once the eligibility criteria are met, applications must be submitted no later than 11:59 PM on July 5, 2025.

Browse our catalogue →

70+

Scientific techniques

443+

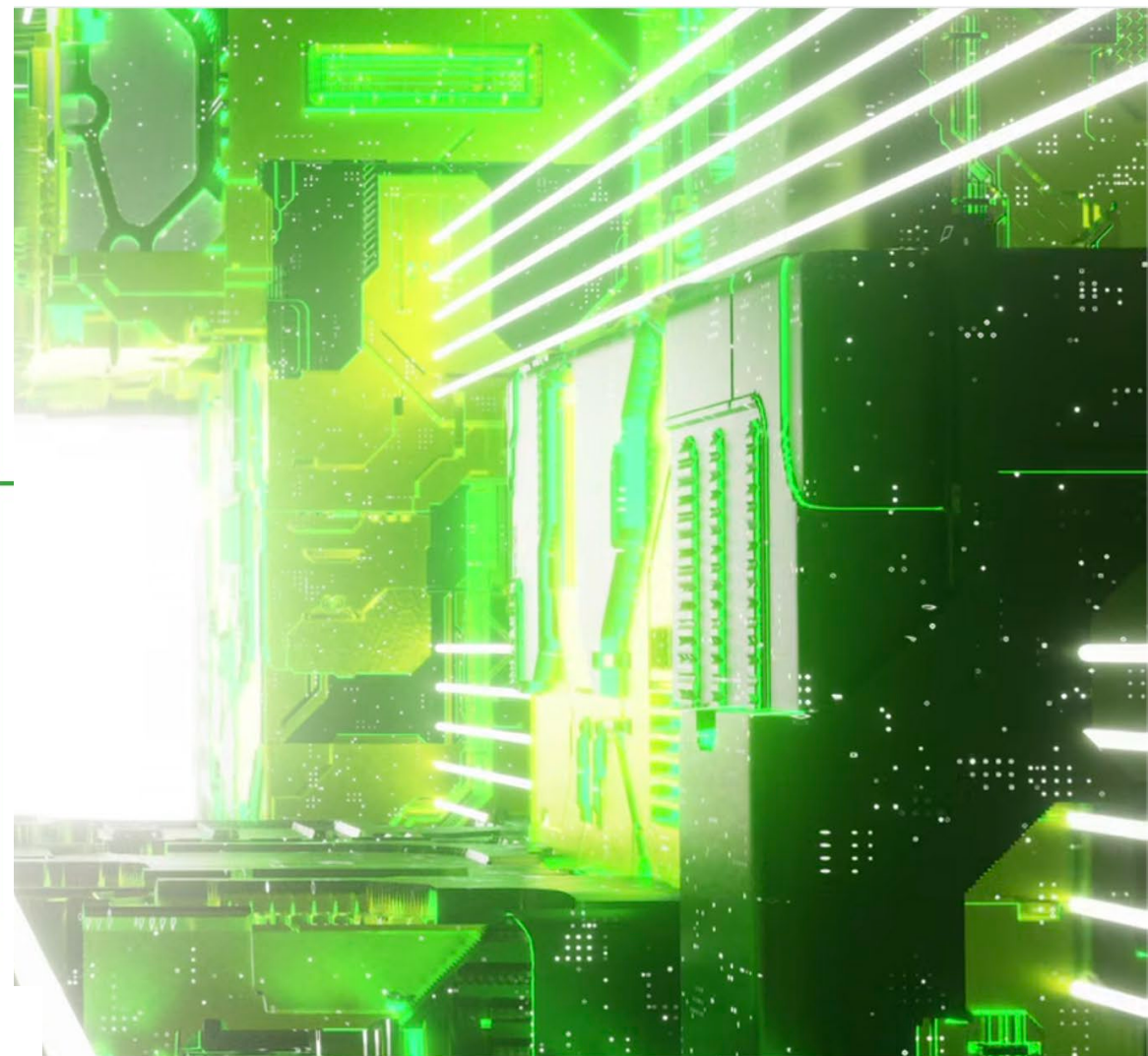
Instruments

70M€+

Investments

80+

Researchers involved



<https://www.ientrance.eu>

In-situ TEM

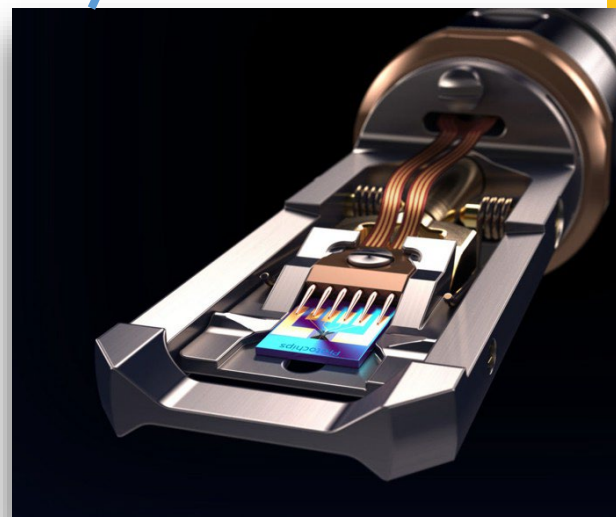


Joint Lab on Electron Microscopy

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNAConsiglio Nazionale
delle Ricerche

O - ring

Specimen Housing



- MEMS BASED TECHNOLOGY

Handle



Holder

FUSION



POSEIDON



DYNAMIC PROCESSES

- Structural changes
- Morphological changes
- Elemental distribution
- Fluidic dynamics
- Device performance
- Reaction properties

Contact persons: **Alessandro Gradone**
(alessandro.gradone@cnr.it) and **Vittorio Morandi**
(vittorio.morandi@cnr.it)



RETE ALTA TECNOLOGIA
EMILIA-ROMAGNA
HIGH TECHNOLOGY NETWORK



TECNOPOLO BOLOGNA CNR



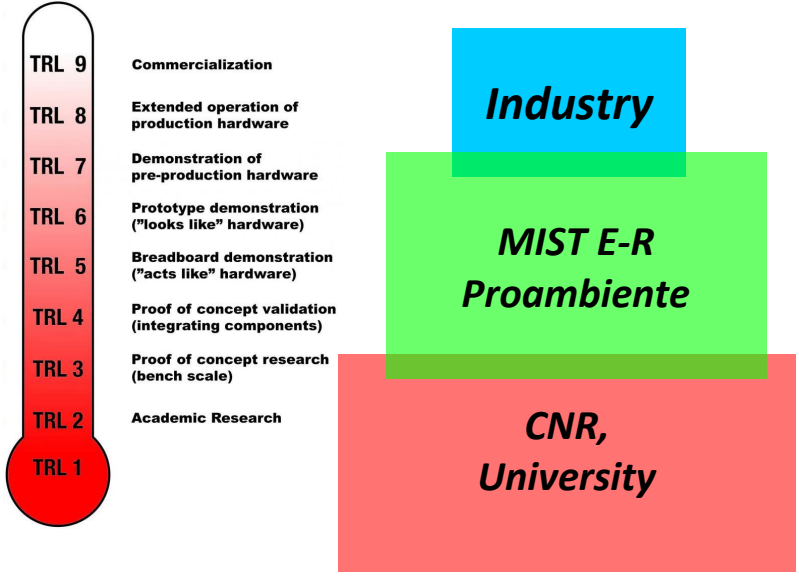
PROAMBIENTE
innovation & environment

<http://www.consorzioproambiente.it>



MISTER
SMART INNOVATION

<http://www.laboratoriomister.it>



Private Public Partnerships
@
TECNOPOLO
CNR BOLOGNA
"AMBIMAT"



**Consiglio Nazionale
delle Ricerche**
Area Territoriale di Ricerca di Bologna

SERVICES FOR COMPANIES

- Information point
- Screening and analysis of technological needs
- Financial instruments for innovation
- Business acceleration
- Open innovation
- Intellectual property consulting
- Event organisation



Industrial Collaborations & Spin-off



saes group

spindox
DIGITAL SOUL

SAMSUNG



**Italiadomani**
PIANO NAZIONALE
DI RIPRESA E RESILIENZA

**ecosister**

**samothrace**

Ecosystem for Innovation

Ecosystem for Energy Transition Emilia Romagna

SiciliAn MicronanOTech Research And Innovation Center (Sicilia)

**PON**
RICERCA E INNOVAZIONE
2014 - 2020

**ART-ER**
ATTRACTIVENESS
RESEARCH
TERRITORY

**FESR**
SICILIA 2014-2020

**POR FESR EMILIA-ROMAGNA**
2014/2020

**REGIONE LAZIO**

**S3**
SMART
SPECIALISATION
STRATEGY
Emilia-Romagna

**FESR**
2014-2020
PROGRAMMA OPERATIVO
REGIONE LAZIO

PON programs

POR-FESR and FSE+ regional programs

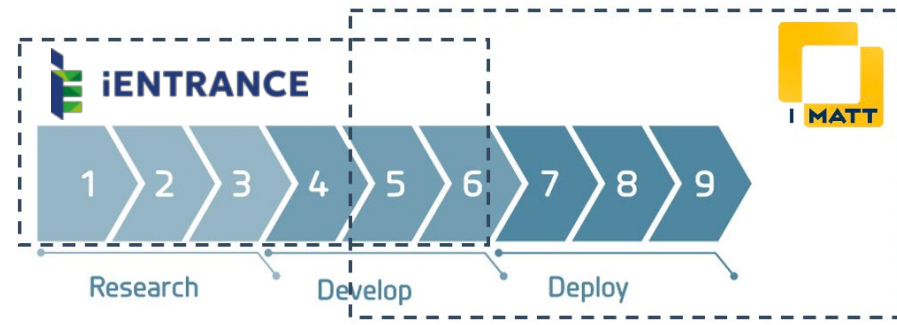
2025

Technological Infrastructures for Innovation

**I-MATT**

I-MATT: The Italian MATerials Technologies Infrastructure

Focus on Develop and Deploy



**CNRISMN**
Istituto per lo Studio dei Materiali Nanostrutturati

**Finanziato dall'Unione europea**
NextGenerationEU

**Italiadomani**
PIANO NAZIONALE
DI RIPRESA E RESILIENZA

- Materials and processes for packaging to enable sustainable packaging
- Materials and processes for advanced mechanics
- Materials and processes for green energy production energy storage
- Materials and processes for recycling and upcycling
- Materials for health

Total Budget
5.4 M€

Total CNR-ISMN Budget:
2.6 M€

Thank you for your kind attention!

Vittorio Morandi <vittorio.morandi@cnr.it>