NANOMICROFAB
ADVANCED LAB

CNR Open Research Infrastructure of micro-nanoelectronics

www.nanomicrofab.eu

Consiglio Nazionale delle Ricerche

Department of Physical Sciences and Technologies of Matter

14/11/2022

PROGETTO COFINANZIATO DALL'UNIONE EUROPEA

FESR Fondo Europeo di Sviluppo Regionale
Programma operativo regionale del Lazio 2014 – 2020

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Partner

- CNR – Dipartimento Scienze Fisiche e Tecnologie della Materia
  - Istituto per la Microelettronica e Microsistemi (IMM-CNR)
  - Istituto Fotonica e Nanotecnologie (IFN-CNR)
  - Istituto Struttura della Materia (ISM-CNR)
- Università di Tor Vergata – Dipartimento Ingegneria Elettronica

4,0 M€	Total cost
2,6 M€	funded by Regione Lazio
1,4 M€	provided by the partners

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Objectives

To set-up a facility allowing to support companies operating in the field of micro-nanoelectronics by providing several services:

- supply new materials
- development of processes and devices
- design and characterization of materials and devices

The facility is expected to self-sustain through the service contracts

- Integrate several CNR existing infrastructures with those of the Univ. of Tor Vergata
- Upgrade the existing infrastructures through the acquisition of new equipment

Application Areas
GaN-based electronics
Flexible and printed electronics
Sensors, microsystems and IoT

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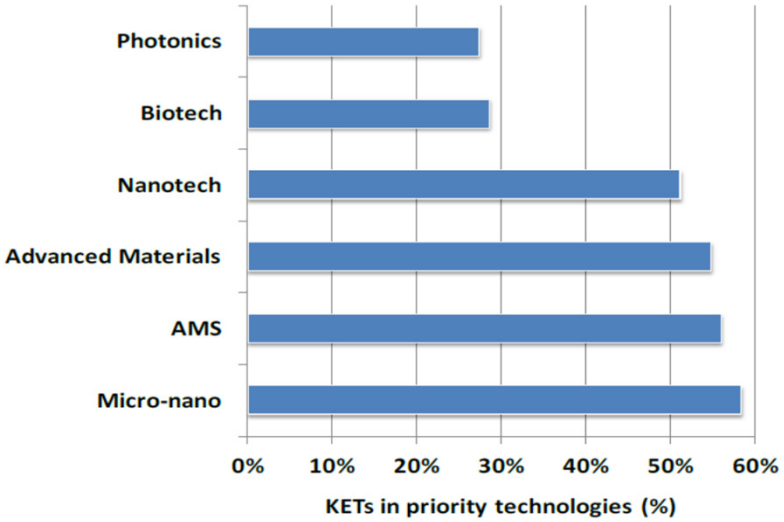
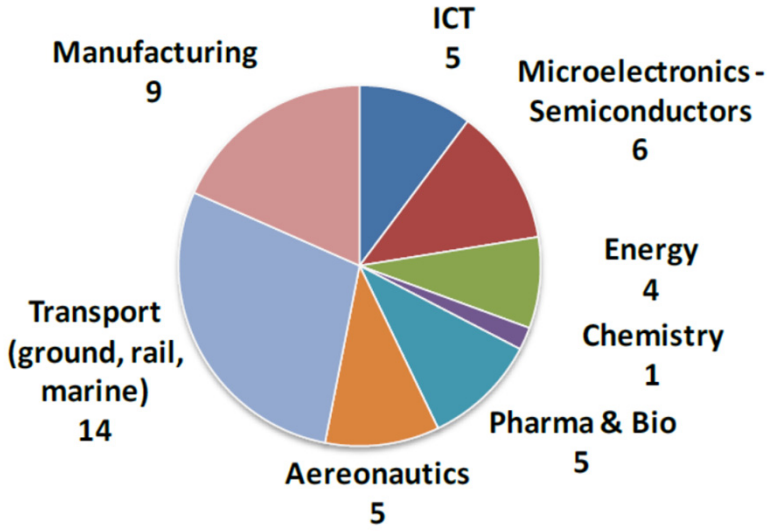
Micro-nanoelectronics as the most pervasive KET



The 6 KET contributions to the 84 Priority Technologies identified by the Italian Association for Industrial Research (AIRI)



Sector distribution of the 49 priority technologies where micro-nanoelectronics is involved (from AIRI)

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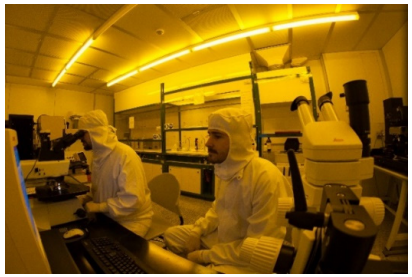
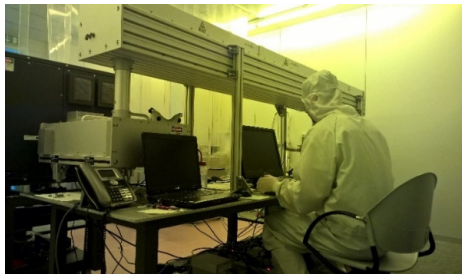
The facility

- Distributed over two main sites
  - Clean-rooms located in the CNR Research Area of Tor Vergata
  - Labs located at the Electronic Engineering Dept. Univ. Tor Vergata
- Rationalize the CNR clean-room facility in Rome
  - Upgrade of clean room located in CNR Area in Tor Vergata to integrate existing clean room facility at IFN and IMM
  - Equipment upgrades and new acquisitions



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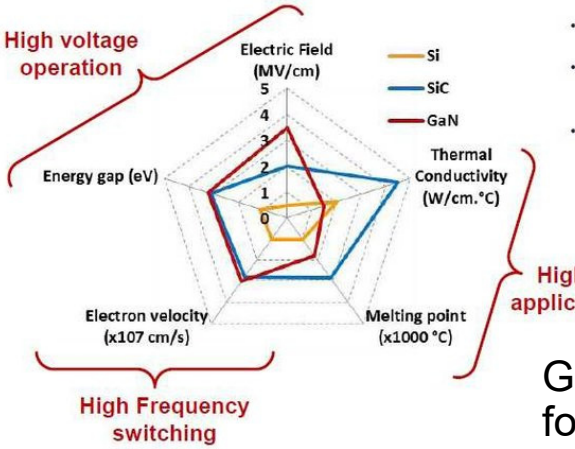
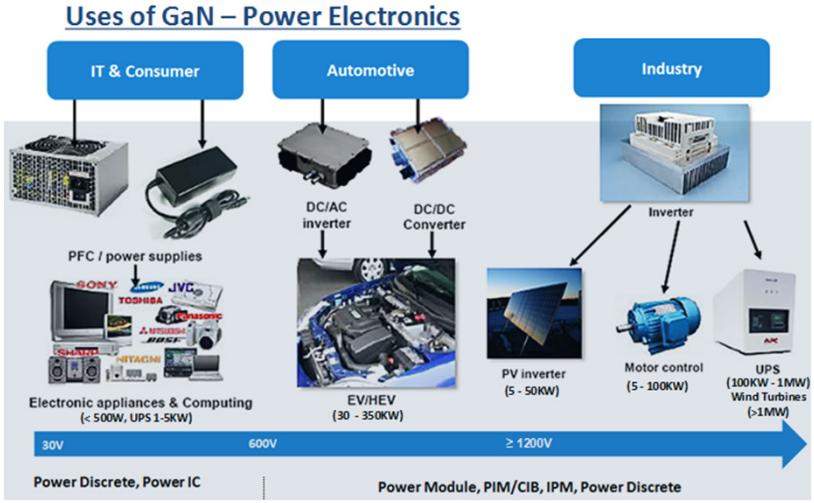
GaN-based electronics

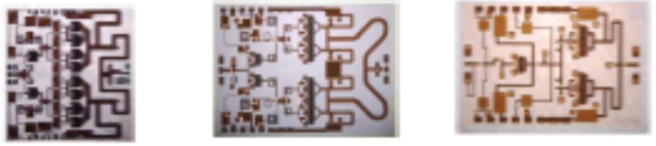


- SiC will stay the preferred choice for high T° application
- GaN could possibly reach high-voltage values but thus will require bulk-GaN as the substrate.
- Silicon cannot compete at the high-frequency range



GaN properties are particularly suitable for applications in power electronics (voltages < 600V) and high frequencies

LEONARDO



100 W S Band HPA GaN HEMT | 25 W C Band HPA GaN HEMT | 15 W X Band HPA GaN HEMT

- Leonardo-Finmeccanica has a GaAs/GaN Foundry for defense and aerospace applications
- CNR, Univ. Tor Vergata and Leonardo have a long standing collaboration on GaN technology and device characterization

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GaN-based electronics

- Upgrade of the characterization an processing tools

for AlGaN/GaN HEMT technology

- Development of fabrication process for GaN devices at CNR labs (upgrade of optical and electron beam lithography)
- Characterization of GaN devices in the high frequency domain (up to 300 Ghz) and thermography to analyse self-heating (Raman and SThM)

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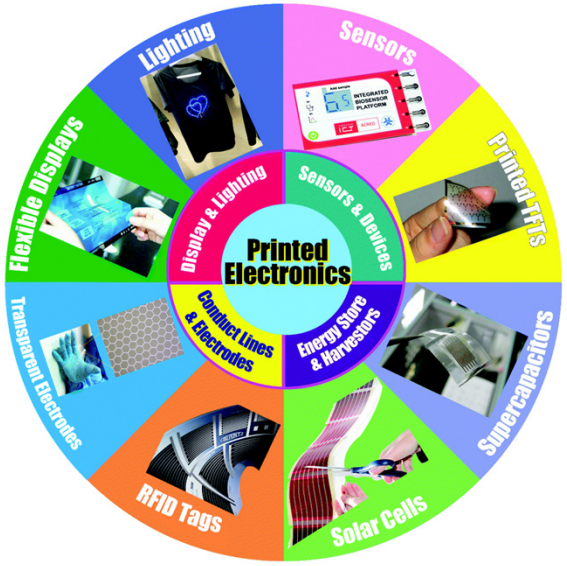
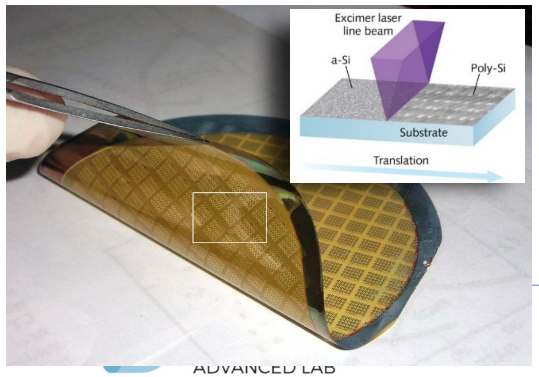
Università di Roma Tor Vergata

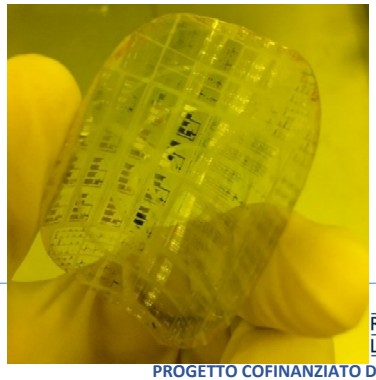
Flexible and Printed Electronics

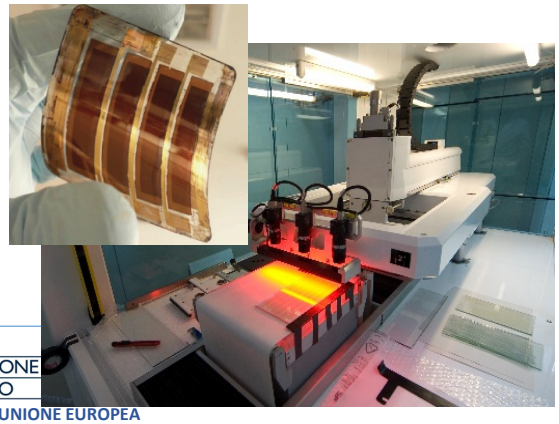


Joint lab between CNR and Univ. Tor Vergata to develop electronic and optoelectronic devices on flexible substrates.
The following technology are available:

- Printing techniques for low-cost organic devices and circuits on flexible plastic substrates
- Printed organic/hybrid solar cells on flexible sustrates.
- High-performance polycrystalline silicon devices and circuits on ultra-flexible substrates based on excimer laser crystallization.







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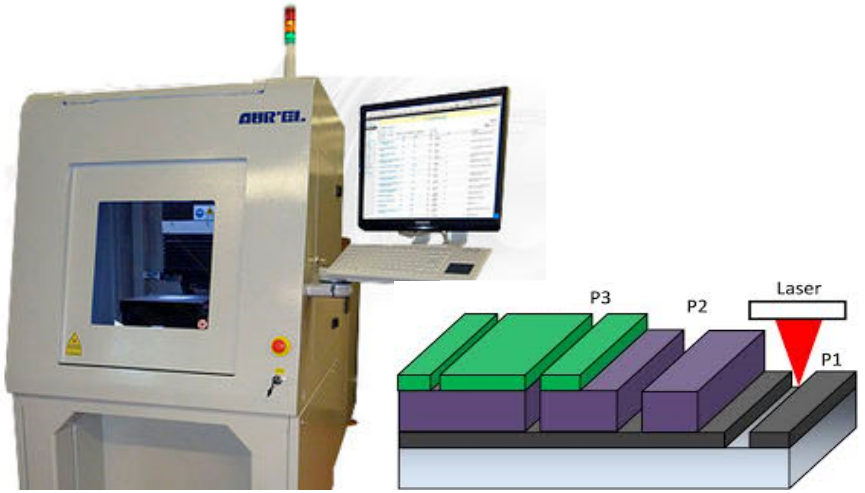
Flexible and Printed Electronics

- The current facility will be upgraded by acquiring new systems

Optical lithography system

Optical lithography system with UV LED light source and for substrates up to 8 inch

Laser scribing and micromachining tool



Selective laser ablation of nanometer material layers for photovoltaic and electronic device fabrication on flexible substrates

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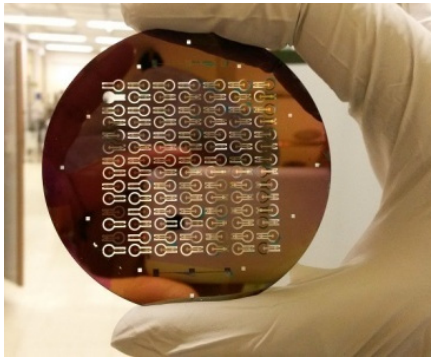
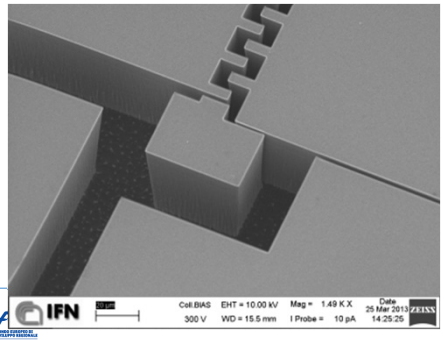
Sensors, Microsystem and IoT

NanoMicroFab will exploit the expertise as well as the equipment available and those to be acquired to offer services and products in the area of sensors and microsystems, including:

- Processes to deposit functional materials and fabricate solid state sensors for chemical and physical sensing (gas sensors, tactile sensors, biosensors, strain gauge, …)
- MEMS (accelerometers, giroscopes, …)
- Microsystems (microbolometers, metamaterials)
- Lab on chip (microfluidic,…)
- Functional characterization of sensors





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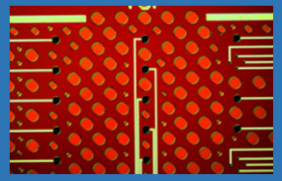
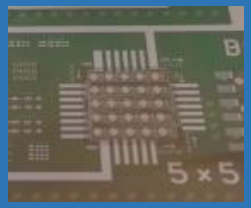
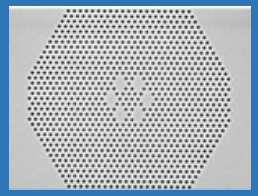
Examples of Sensors and Microsystem



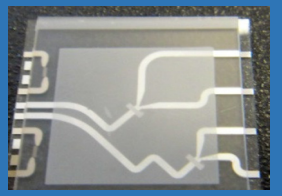
Ultra-flexible microelectrode arrays for in vivo measurements



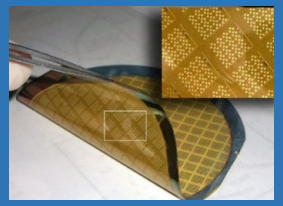
Array of capacitive pressure sensors



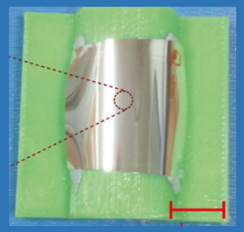
Photonic Crystal Nanocavities for gas and strain sensing



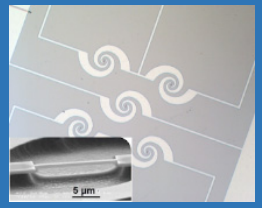
Surface acoustic wave sensors



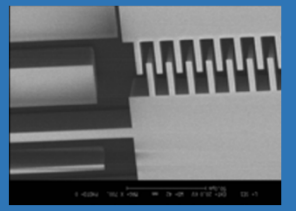
Gas sensors for environmental monitoring



THz flexible filter as sensor of bending radii

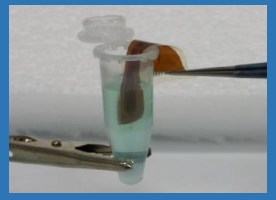


Waveguide Single Photon Detectors

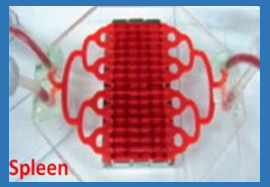


Micro Electro-Mechanical Systems

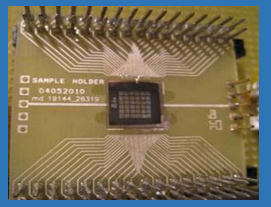
Wearable sensors



Disposable biomedical devices



LabOnChip



Sensors for ionising radiation detection

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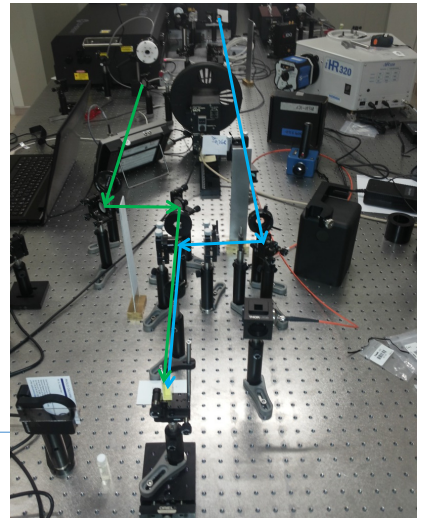
Device Characterization

- DC and AC electrical characterization at different temperatures
- Thermal characterization of the devices (self-heating)
- Failure analysis, technology yield, aging, and long-term measurements.
- High frequency electrical characterization (up to 300 GHz, 3 Vector Network Analysers (0.05-300 GHz), 2 Spectrum Analyser (3Hz-50GHz) Noise Measurement System (DC-40 GHz), Cryogenic Probe Station to 40 GHz)

Materials Characterization



- Scanning probe microscopy
- X-ray diffraction
- Photoemission spectroscopy
- Optical spectroscopy (UV-Vis, FTIR, Raman)
- Ultra-fast optical spectroscopy

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Companies that have already expressed interest in services offered by the NanoMicroFab facility

- Airgloss (Roma, Italia)
- Fondazione BIETTI (Roma, Italia)
- CAEN SpA (Viareggio, Italia)
- DUNE srl (Roma, Italia)
- Fonderie Digitali (Roma, Italia)
- Global Solar Fund Eng. (Roma, Italy)
- INFN (Frascati, Italia)
- IDIBABS (Barcellona, Spagna)
- Ionvac Process (Pomezia, Italia)
- Leonardo-Finmeccanica (Roma, Italia)
- LFoundry (Avezzano, Italia)
- Fondazione INUIT (Roma, Italia)
- MITEC srl (Roma, Italia)
- NANOFABER srl (Roma, Italia)
- New Tech System Generation, NTSG, (Roma, Italia)
- Peopletrust srl (Roma, Italia)
- PPG Italia Business Support Srl (Milano, Italia)
- Progetti Speciali Italiani srl (Roma, Italia)
- SUPERELECTRIC (Tempio Pausania, Italia)
- Wave UP srl (Firenze, Italia)

Great attention will be paid to companies located in the Regione Lazio, however, thanks to the European integration of the NanoMicroFab facility, it will be possible to offer services to a much wider market

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It-fab

Italian Network for
Micro and Nano Fabrication

http://itfab.bo.imm.cnr.it

It-fab an initiative that aims to

- establish harmonized rules, for clean room management and access policies, IP rules, external costs and reporting
- harmonize and share design and simulation software, service contracts, management of professional services
- define joint best practices for reciprocal support and backup, complementarities, standardization of clean room practices, interoperability and data exchange formats
- define common information system for know-how, projects and equipment databases.

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It-fab is partner of the EuroNanoLab initiative (http://euronanolab.com)