Centro di ricerca per le Nanotecnologie applicate all'Ingegneria di Sapienza (CNIS)

Sapienza Nanotechnology & Nanoscience Laboratory (SNN-Lab)

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Direttore CNIS

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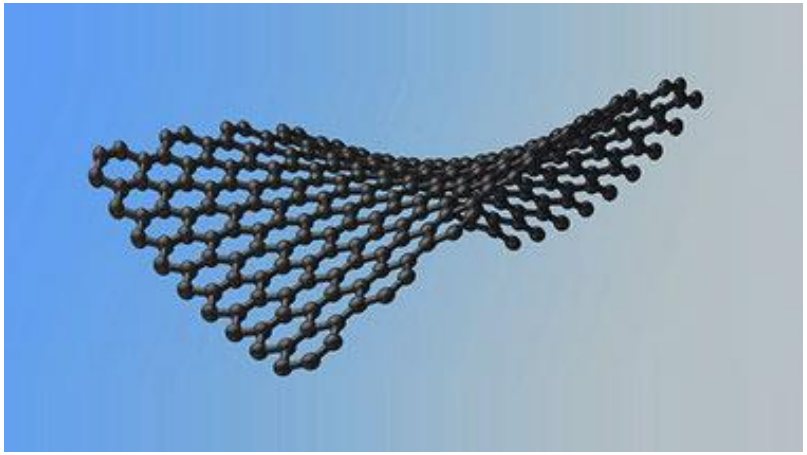
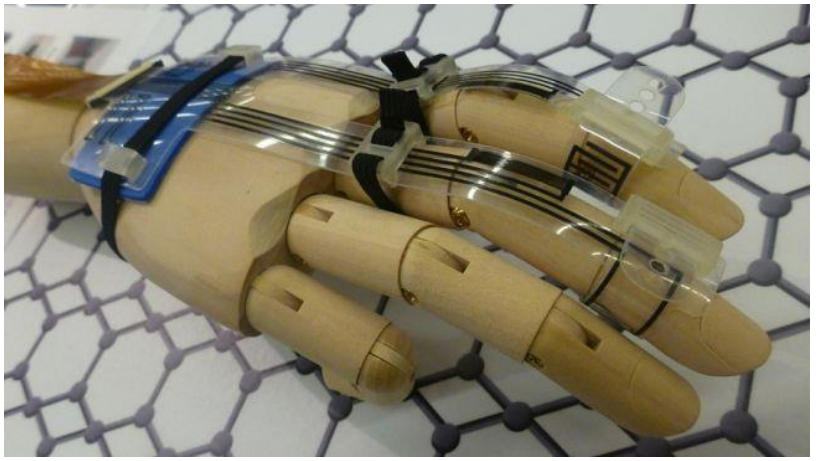
CNIS

SNN Lab Sapienza Nanotechnology & Nanoscience Lab

Nanotecnologie

- 1 nm = 10^{-9} m
- Controllo della materia alla nanoscala per progettare e realizzare nuovi materiali, dispositivi e sistemi
- Approccio multidisciplinare (Chimica, Fisica, Biomedicina, Ingegneria) apre nuovi scenari applicativi





C N I S

- Fondato nel 2006
- Scopo: promuovere e sviluppare attività di ricerca sulle nanotecnologie, finalizzata al trasferiemento tecnologico e alla creazione di nuovi materiali, dispositivi per molte applicazioni (elettronica, energia, aerospazio, medicina, biotech, ...)
- Rete di ricerca multidisciplinare:
  - più di 80 ricercatori di diverse aree scientifiche (Ingegneria, Scienze, Medicina)
  - 15 Dipartimenti
- Laboratori:
  - struttura comune SNN lab (Sapienza Nanotechnologies and Nanoscience Lab)
  - Una rete di laboratori specialistici nei vari Dipartimenti
- Laurea Magistrale in Ingegneria delle Nanotecnologie
- Dottorato in Nanotecnologie
- Trasferimento Tecnologico

Dipartimenti di Sapienza affiliati al CNIS

Ingegneria

- Dipartimento di Ingegneria Astronautica, Electrica and Energia (DIAEE)
- Dipartimento di Scienze di Base Applicate all'Ingegneria (SBAI)
- Dipartimento di Ingegneria Meccanica e Aerospaziale (DIMA)
- Dipartimento di Ingegneria Strutturale e Geotecnica (DISG)
- Dipartimento di Ingegneria dell'Information, Elettronica e Telecomunicazioni (DIET)
- Dipartimento di Ingegneria Chimica, Materiali e Ambiente (DICMA)

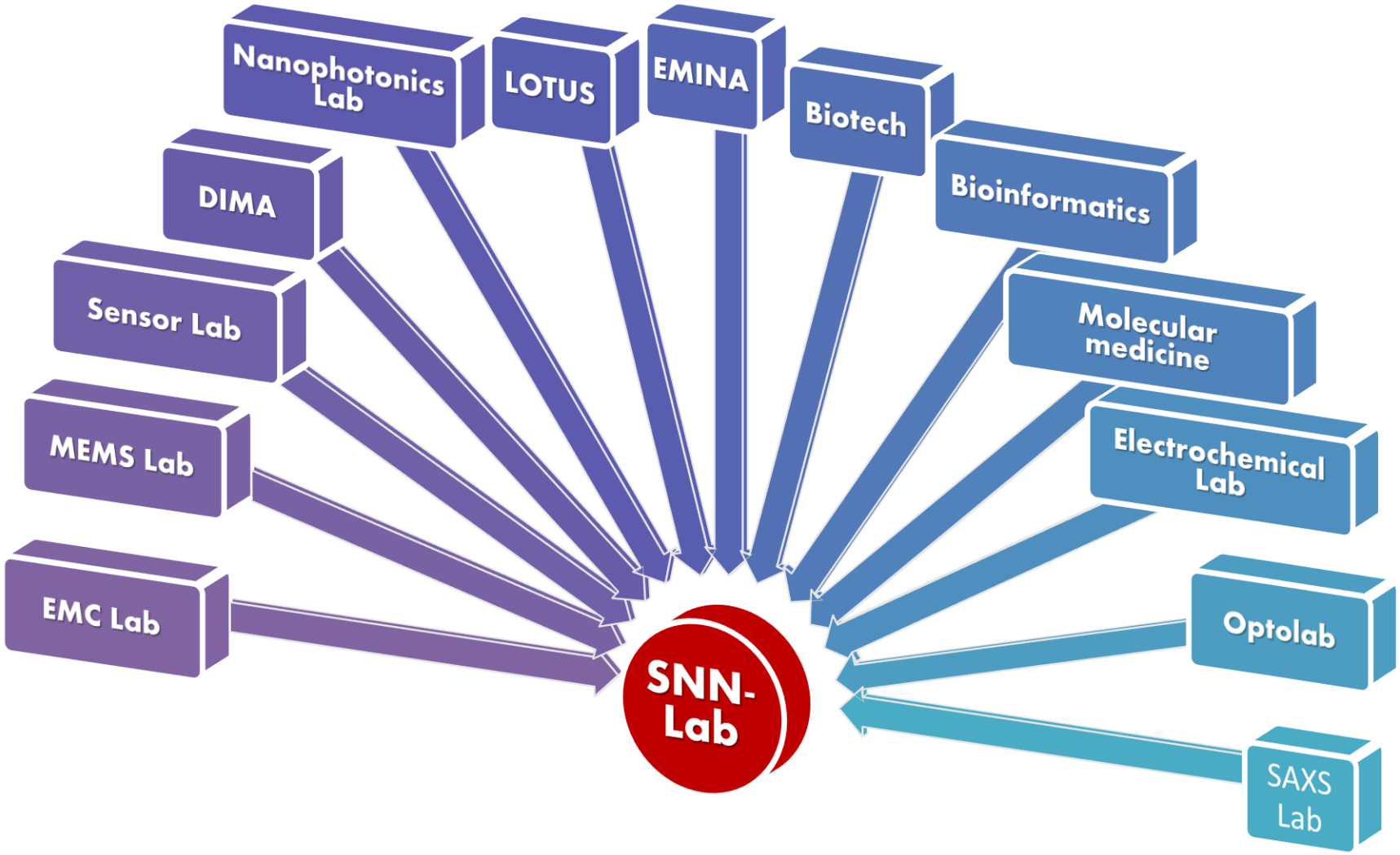
Scienze

- Dipartimento di Fisica (DF)
- Dipartimento di Chimica (DC)
- Dipartimento di Scienze della Terra (DST)
- Dipartimento di Biologia and Biotecnologie "Charles Darwin" (DBBCD)
- Dipartimento di Scienze Biochimiche "A. Rossi Fanelli" (DSBARF)

Medicina

- Dipartimento di Salute Pubblica e Malattie Infettive (DSPMI)
- Dipartimento di Chimica e Tecnologia del Farmaco (DCT)
- Dipartimento di Medicina Clinica e Molecolare (DMCM)
- Dipartimento di Medicina Molecolare (DMM)

SNN-Lab: Infrastruttura di ricerca in Sapienza per le ricerche multidisciplinari sulle Nanotecnologie

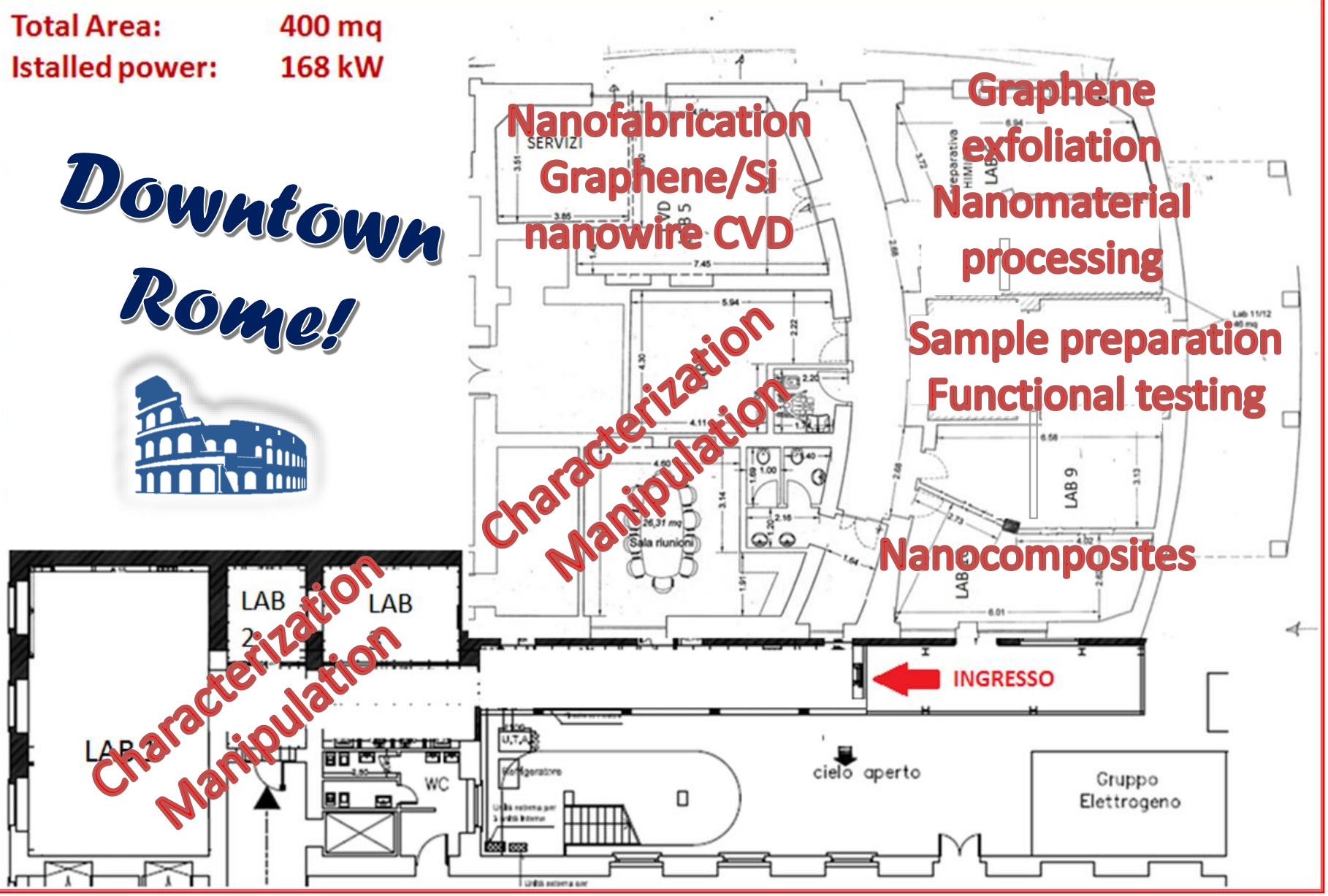


Sapienza Nanotechnology & Nanoscience Laboratory – SNN-Lab

A 400 m^2-core facility at Sapienza University focused on advanced research and technology transfer

Total Area: 400 mq
Istalled power: 168 kW

Downtown Rome!



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SNN Lab
Sapienza Nanotechnology & Nanoscience Lab

Linee di ricerca e applicazioni

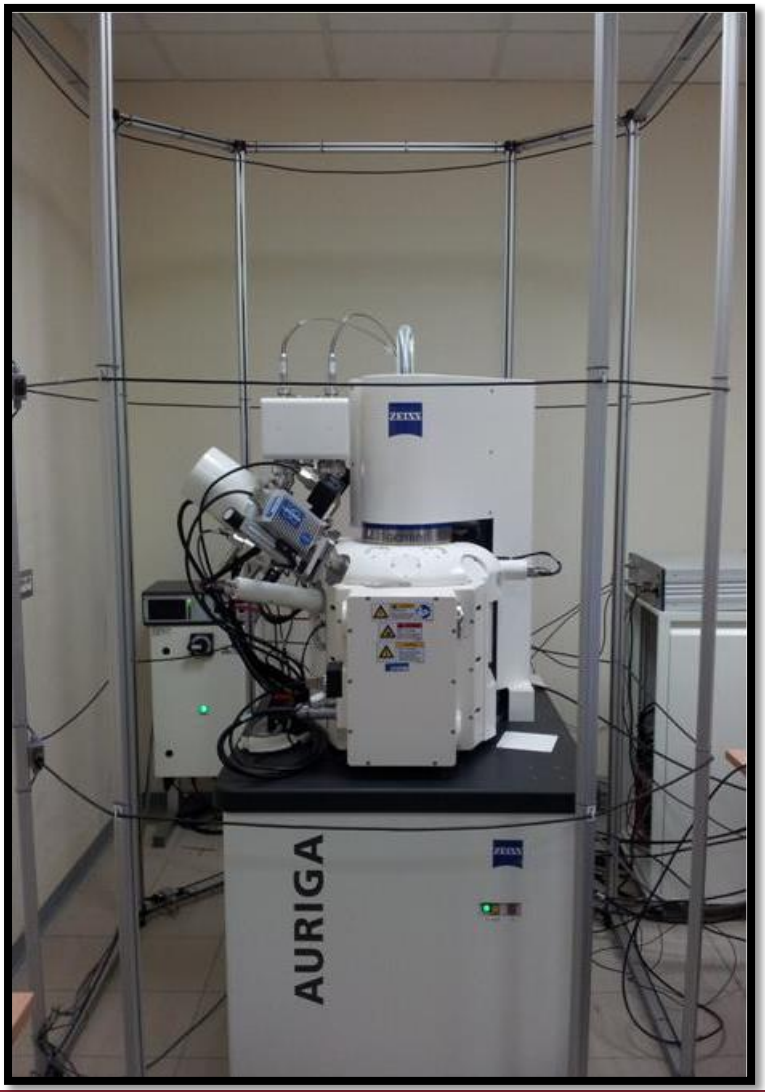
- *Grafene e nanomateriali a base grafene*
- *Nanomateriali Multifunzionali per l'**aerospazio (schermi antiradar, monitoraggio strutturale)***
- *Nanostrutture e nanodispositivi per **elettronica e fotonica***
- *Materiali nanostrutturati **per l'energia (energy harvesting) e il fotovoltaico***
- *Nanomateriali e and superfici intelligenti multifunzionali per **applicazioni industriali***
- *Biomateriali per **applicazioni biomediche***
- *Nanotecnologie per il patrimonio dei **beni culturali (conservazione, diagnostica, protezione)***
- *Nanotossicità, **bio-sensori***

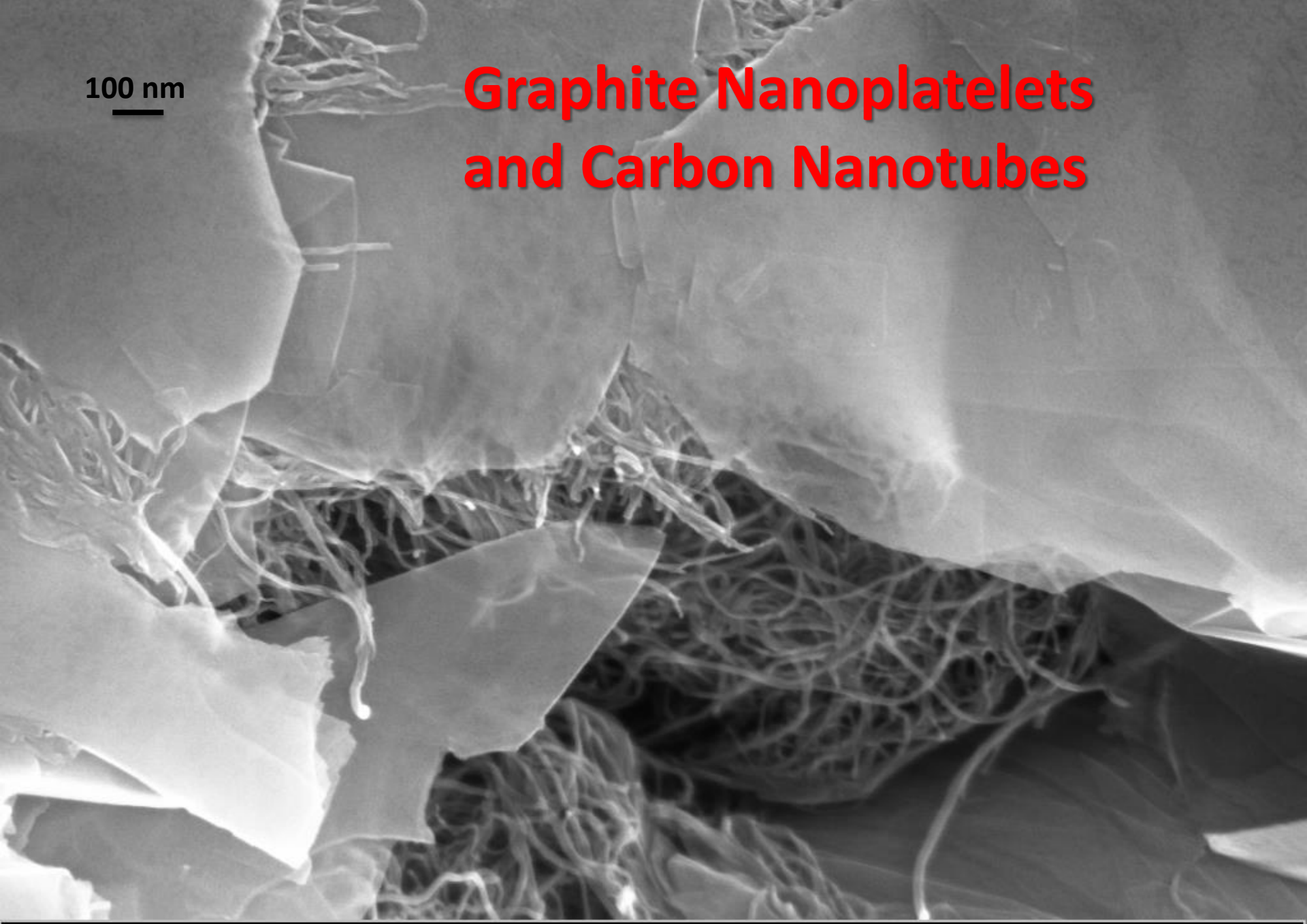
AREA 1: Microscopie e caratterizzazione alla Nanoscala

Electronic Microscopy Platform/ nanofabrication /nanomanipulation:

HR FESEM Zeiss Auriga Microscopy (res. 1 nm), equipped with:

- STEM detector
- Microanalysis EDS ≤ 123 Mn-Kα eV (Bruker)
- Electron Beam Lithography - EBL (resolution 7 nm) (Raith)
- Focused Ion Beam– FIB (resolution 2.5 nm) and GIS
- 4 nanomanipulators Klendieck for electrical / mechanical characterizations on areas of 50 nm^2
- Correlative microscopy (from macro to nano)



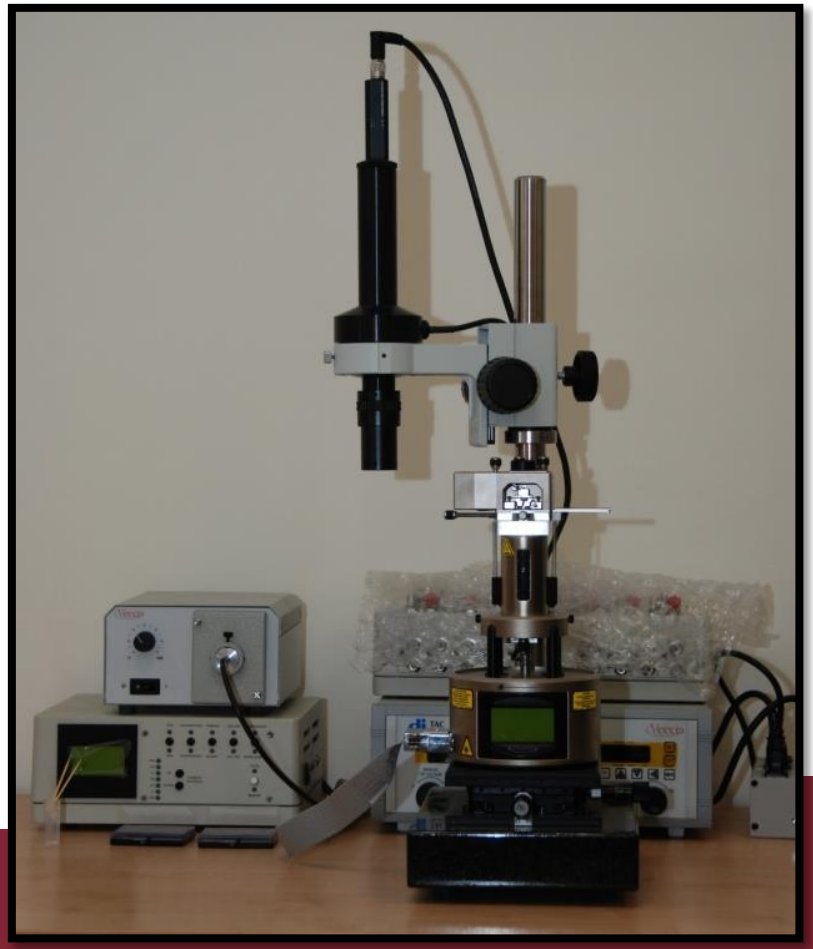

100 nm
Graphite Nanoplatelets
and Carbon Nanotubes
Mag = 117.19 K X
100 nm
Auriga-39-45
WD = 4.5 mm
FIB Imaging = SEM
EHT = 5.00 kV
Noise Reduction = Line Avg
Signal A = InLens
FIB Probe = Undefined
Date :31 May 2011 Time :14:47:38
System Vacuum = 2.45e-006 Torr

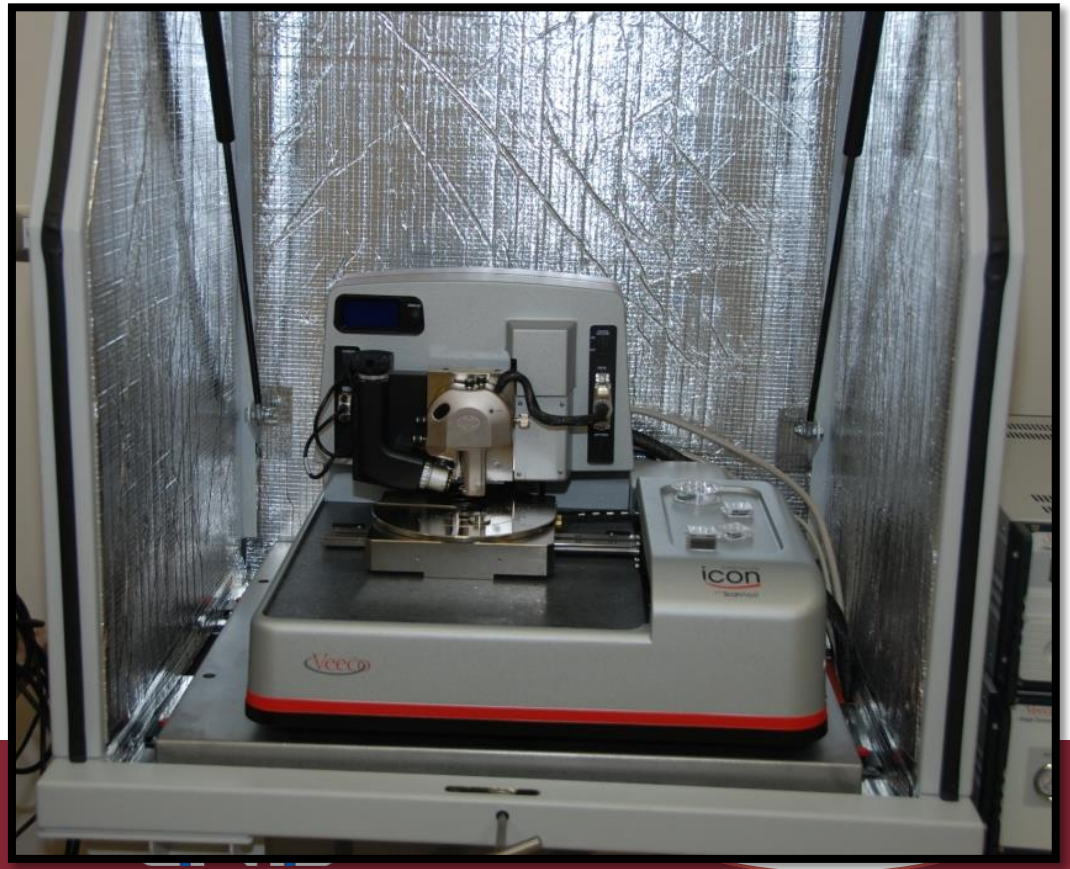
AREA 1: Microscopie e caratterizzazione alla Nanoscala

Atomic Force Microscopy - AFM – Bruker (ex-VEECO) for nanocharacterization and nanomanipulation

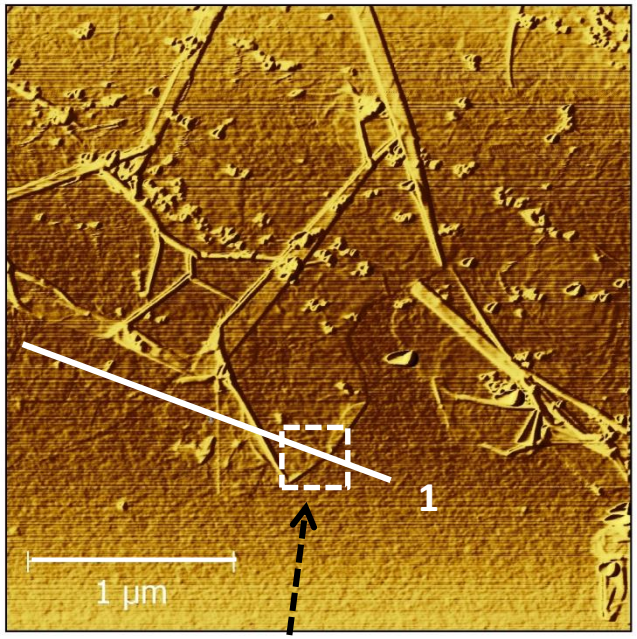
- ICON (controller Nanoscope 5 + Harmonics)
- Multimode (controller Nanoscope 3)

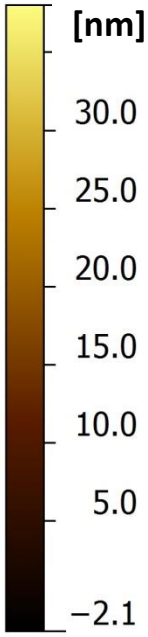
- *Modules for material characterizations (both solid, liquid and bio) and functional characterizations*

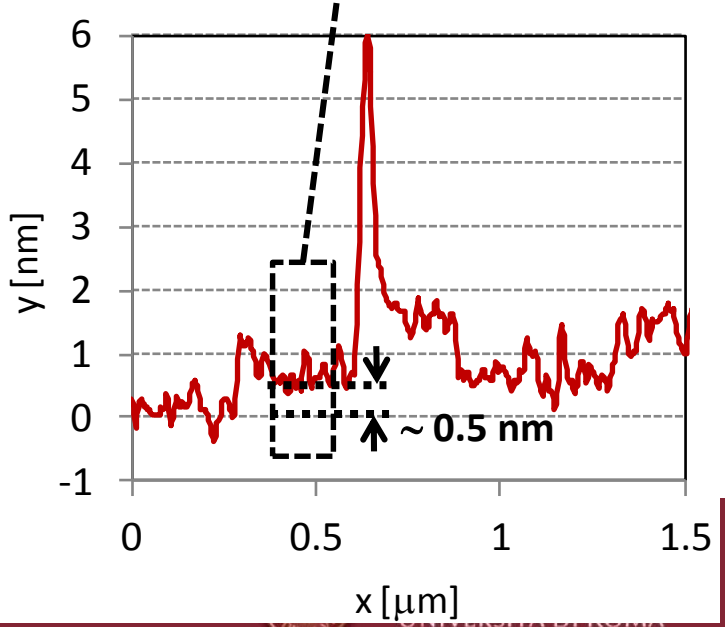


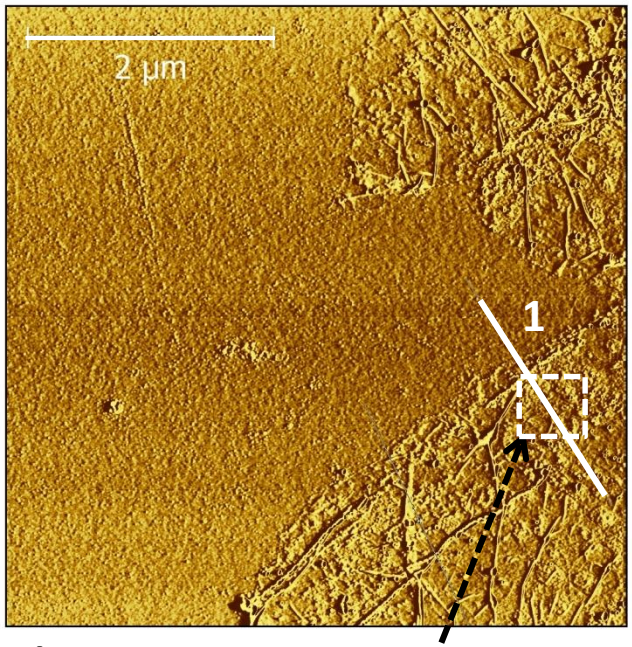


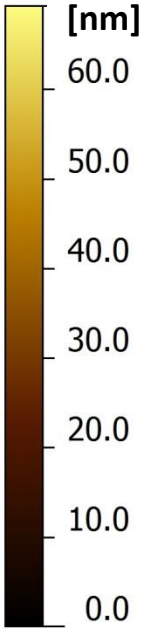
Grafene

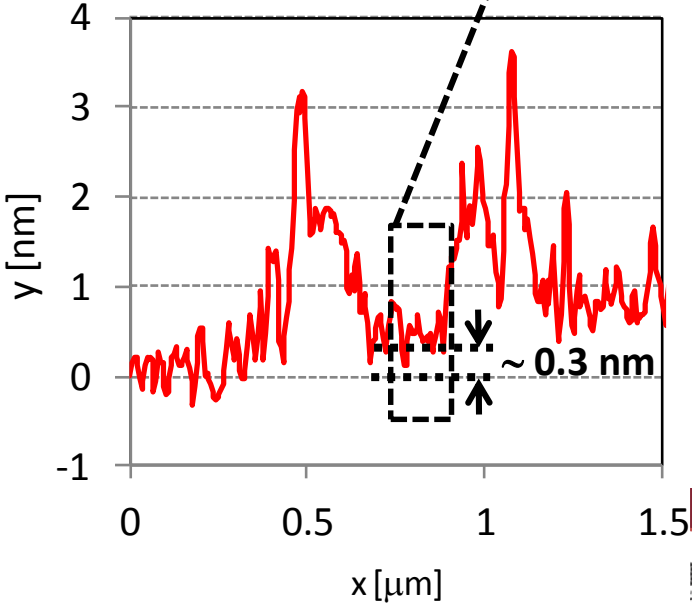

1 µm
1


[nm]
30.0
25.0
20.0
15.0
10.0
5.0
−2.1


y [nm]
x [µm]
~ 0.5 nm

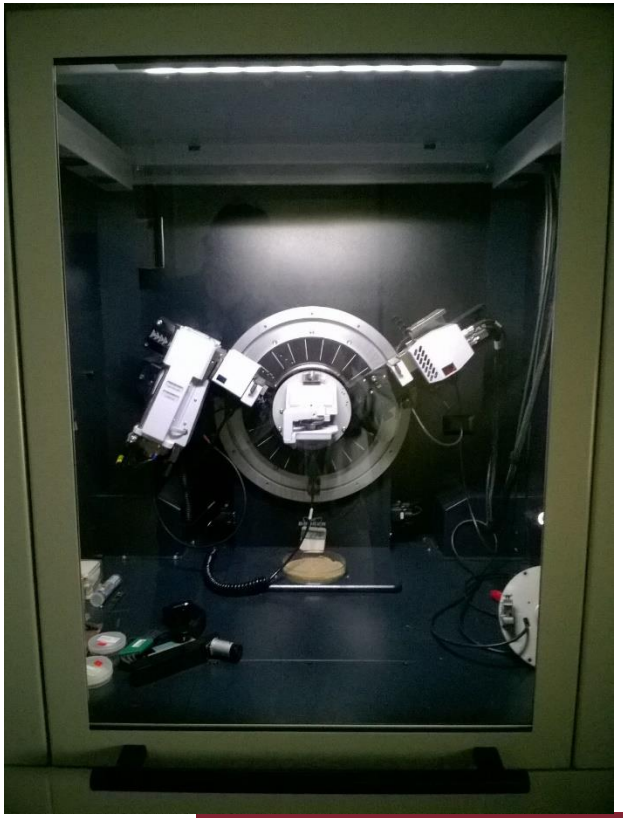

2 µm
1

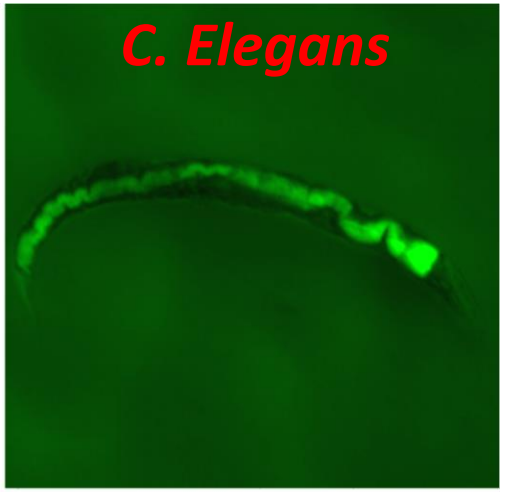

[nm]
60.0
50.0
40.0
30.0
20.0
10.0
0.0

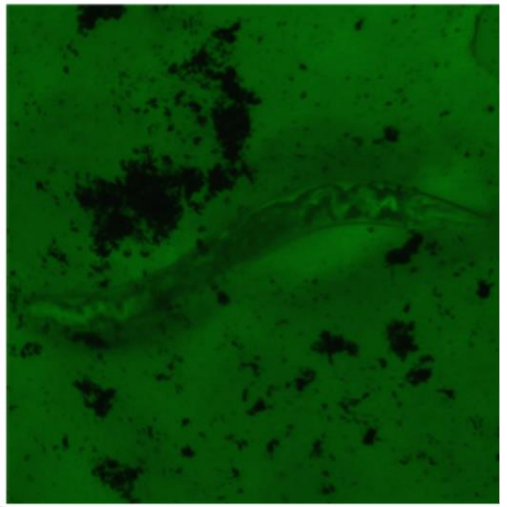

y [nm]
x [µm]
~ 0.3 nm

AREA 1: Microscopie e caratterizzazione alla Nanoscala

- **X-ray diffractometer - XRD**
- **Zeiss fluorescence confocal optical microscopy for *live imaging***
- ***Correlative microscopy (FESEM-Optical microscopy)***







AREA 2: Nanofabricazione

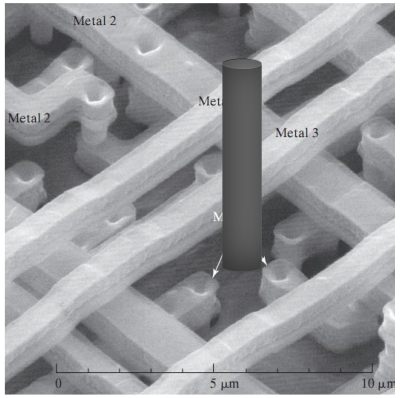
Deposizione MWCVD per la crescita di nanofili di carbonio e silicio

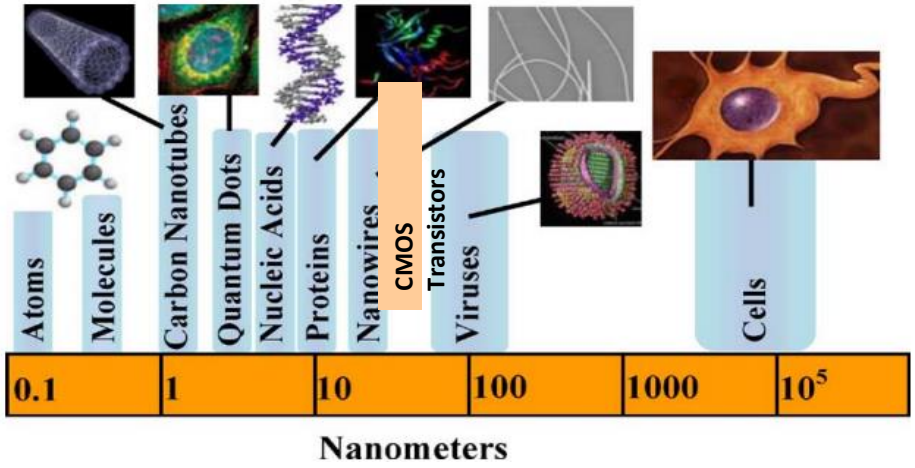
Applicazioni:

- **Celle Solari Nanostrutturate**
  - **Giunzioni NW-Si / ZnO**
  - **Silicio Macroporoso in film sottili**
- **NW-MOS transistors, per nanosensori biologici**

Dual-room CVD deposition system for the fabrication of silicon nanowires, graphene-based CMOS technology, biosensors

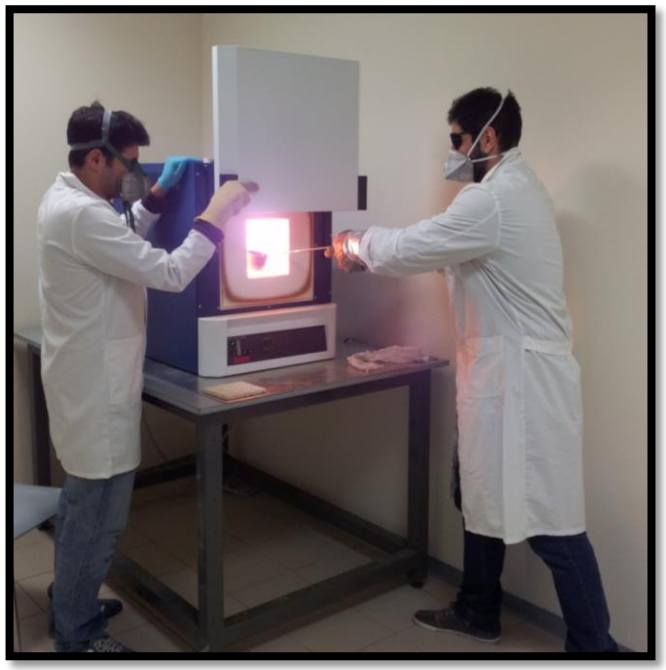
Adding "wires" to a CMOS circuits means to provide them with the capability of sensing and actuation outward biological world





AREA 3: Nanocompositi, materiali a base grafene

- Muffle furnace (1400 ° C) for the production of graphene / graphite nanoplatelets (GNP)
- Rotational Rheometer with electro-module
- Nanocomposite processing and production

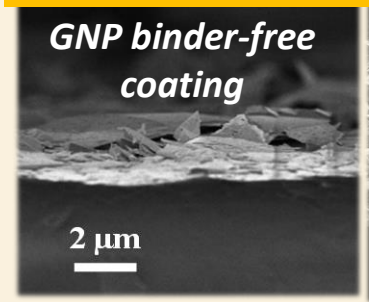


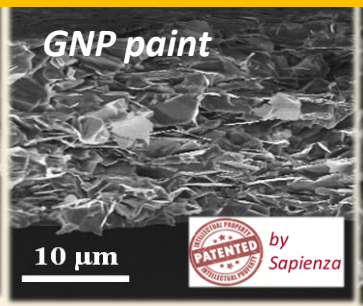
AREA 4: Processi e fabbricazione

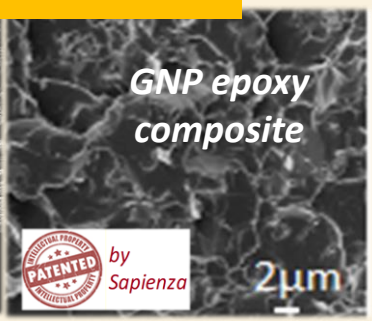
- Fume hood
- Metal Sputtering
- Carbon evaporator
- Furnace
- Functionalization / targeting of molecular and supramolecular structures

GRAPHENE & Zno BASED NANOMATERIALS

MATERIALI SCHERMANTI / ASSORBENTI; SENSORI





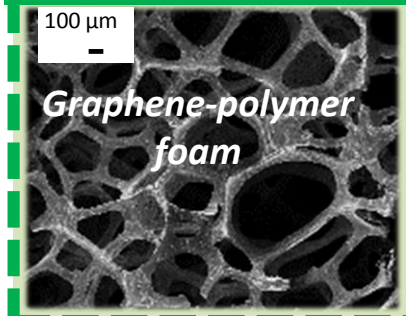


M.S. Sarto *(Group Leader)*

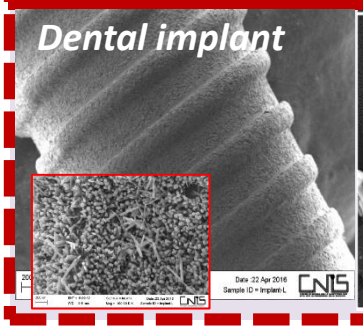
A. Tamburrano, F. Marra, A. D'Aloia, G. De Bellis, H. Cheraghi, M. Fortunato, L. Bellam, I. Bellagamba

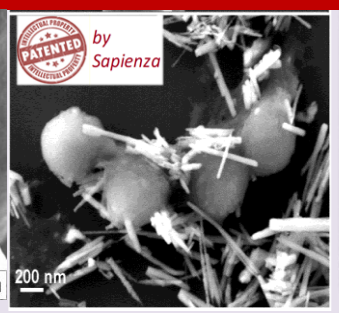
in collaboration with research groups lead by A. Polimeni and D.Uccelletti

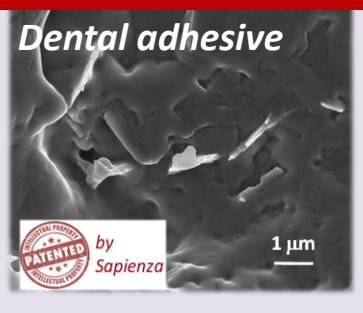
SENSORI, ELETTRODI, DRUG DELIVERY



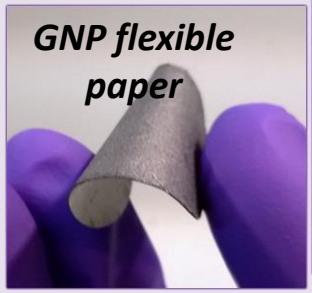
SOSPENSIONI E SUPERFICI ANTIMICROBICHE/ ANTIBIOFILM

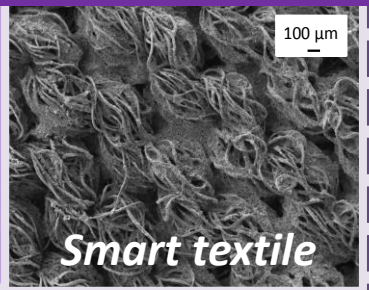




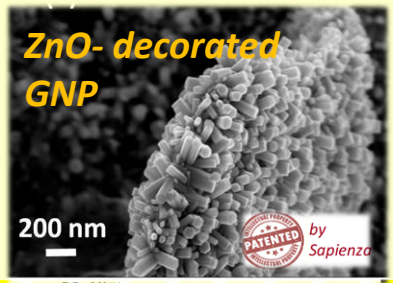


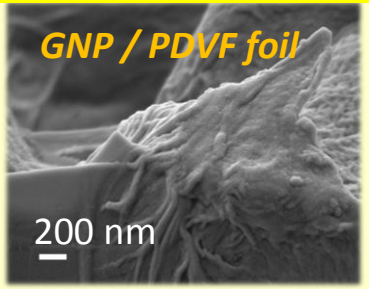
SENSORI INDOSSABILI, CONDUTTORI FLESSIBILI, TESSUTI SMART





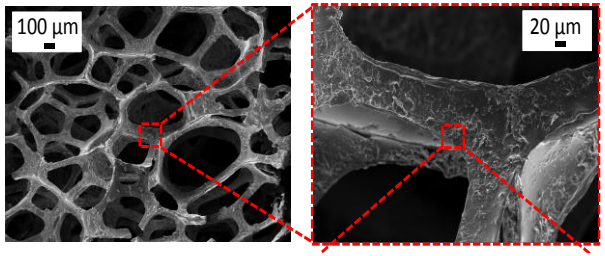
ENERGY HARVESTING, SENSORI PIEZOELETTRICI



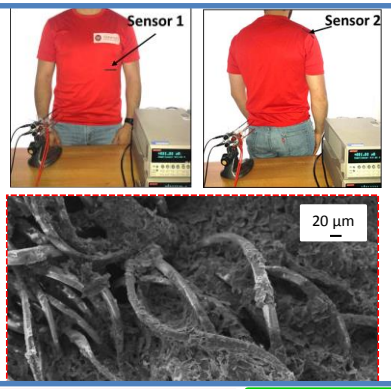


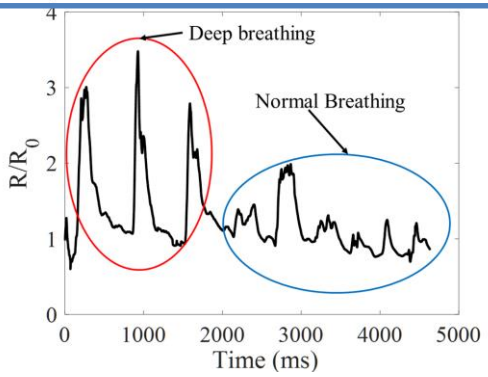
Wearable graphene-based strain sensors

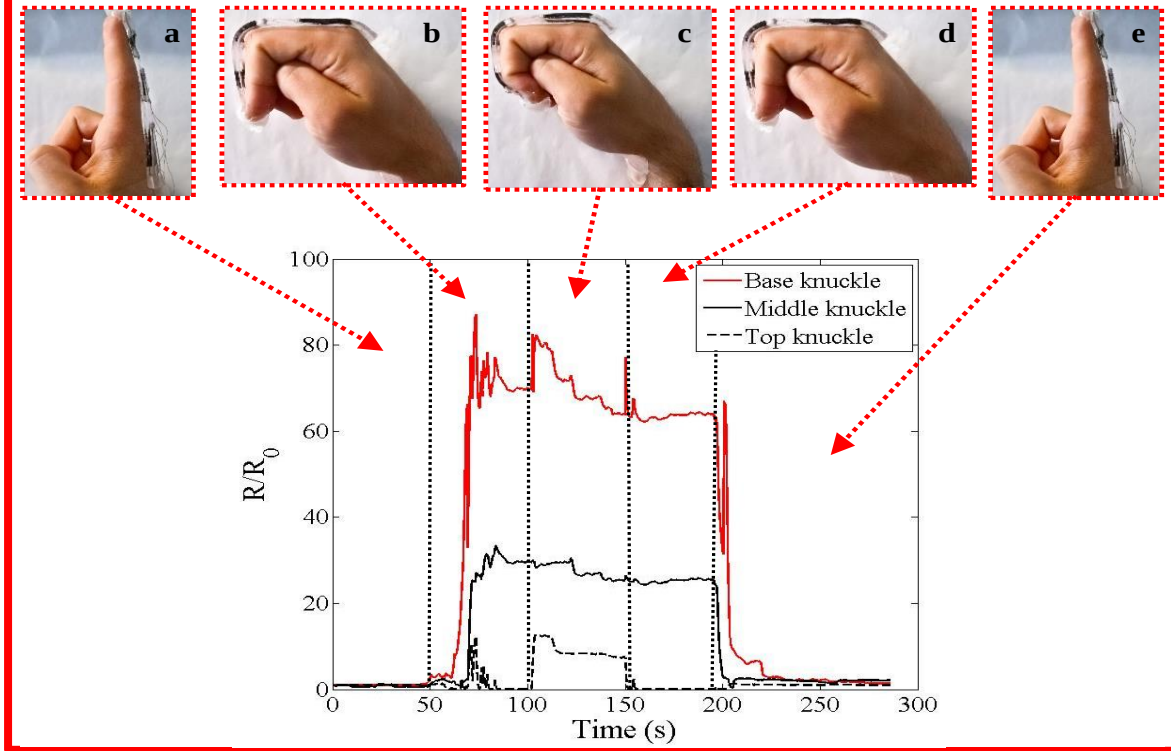
Wearable graphene-based soft sensors



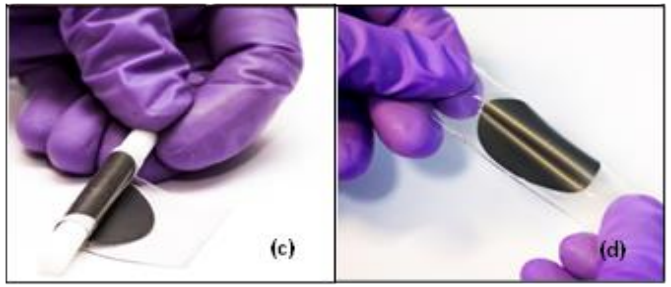
Smart Textile for Kinesthetic Monitoring

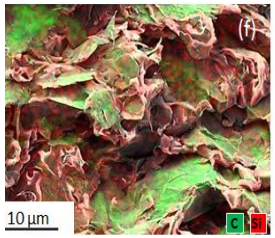


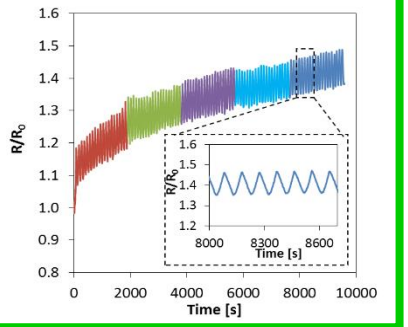




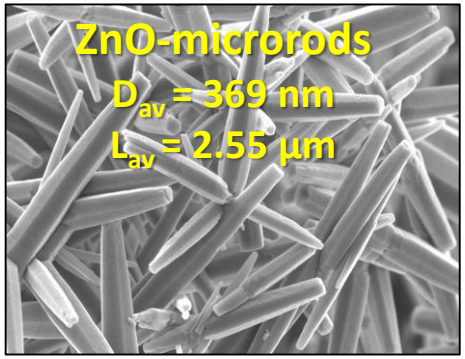
Highly-stretchable graphene sensors

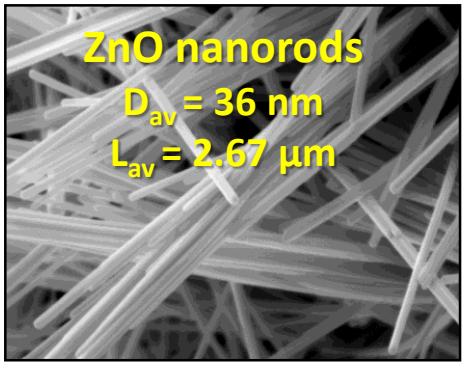


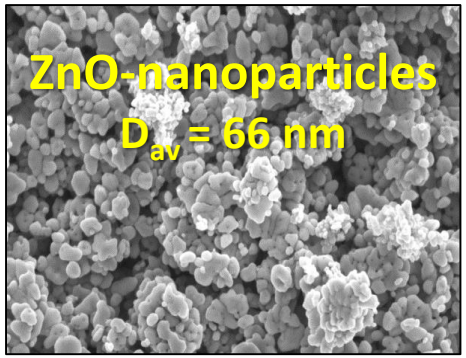




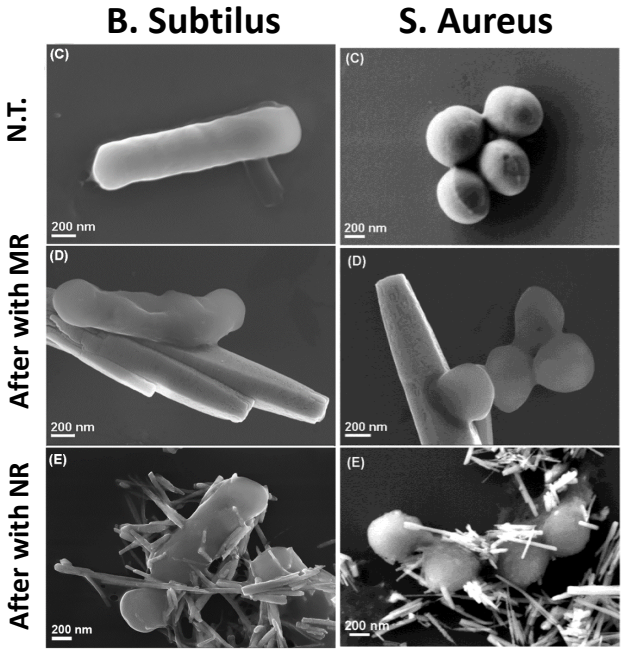
Nanotechnology for cultural heritage



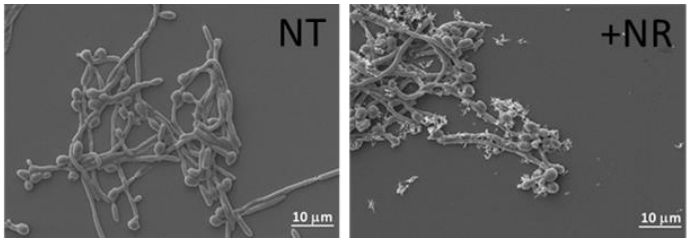


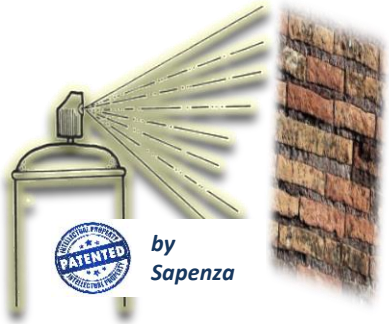


Antimicrobial treatments

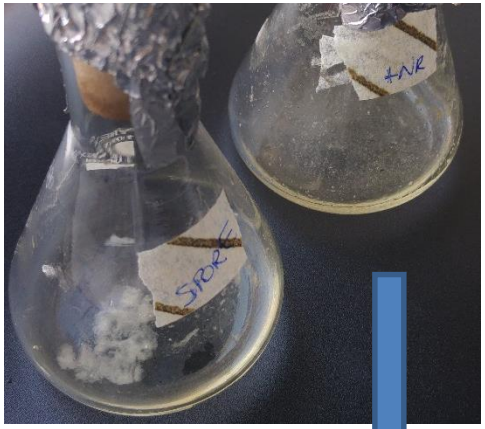


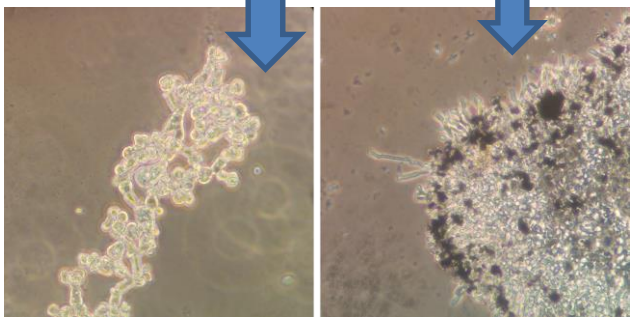
Candida albicans





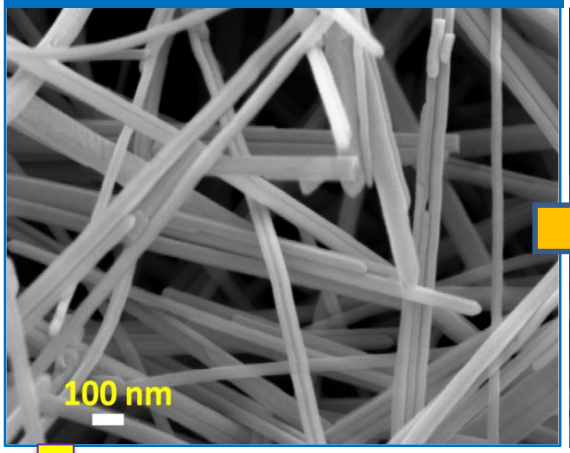
Penicillium



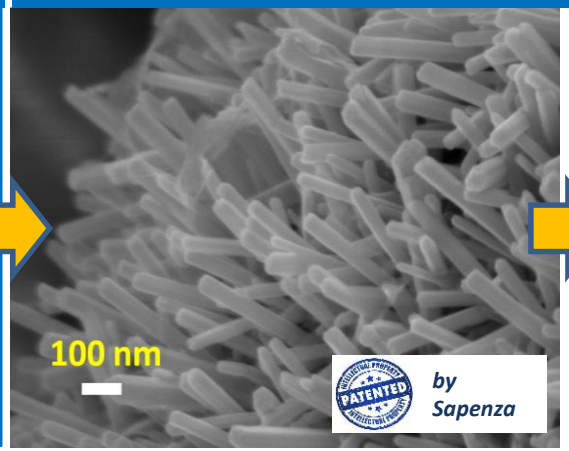


Piezoelectric graphene-ZnO nanomaterials for energy harvesting and sensing

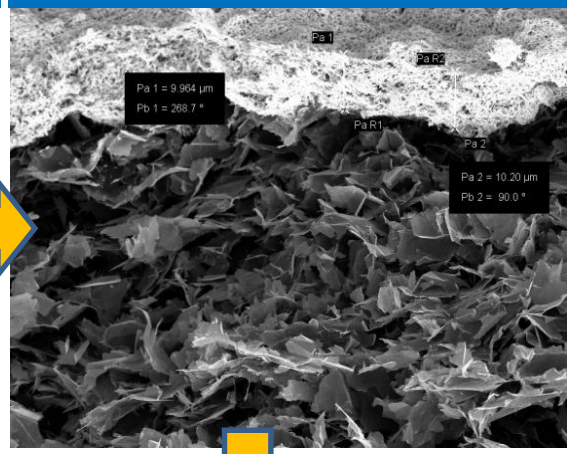
ZnO-nanorod

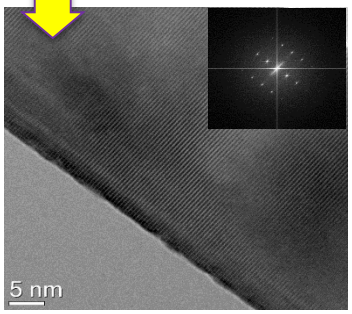


ZnO-nanorod decorated graphene

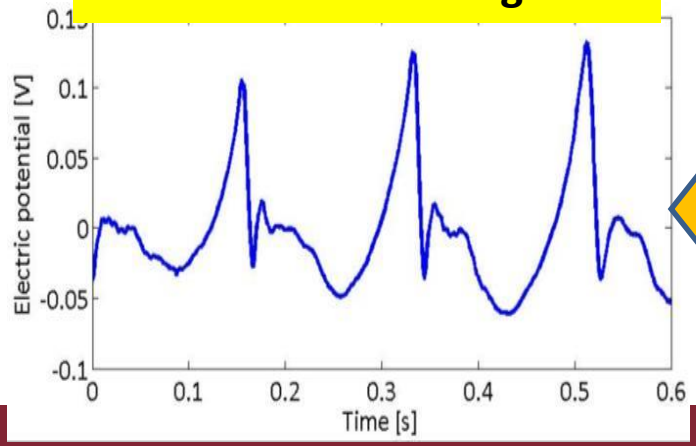


Graphene/ZnO-nanorod papers



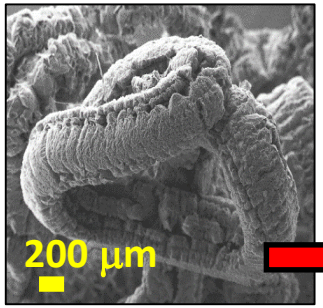


Measured voltage

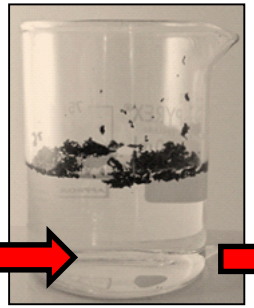


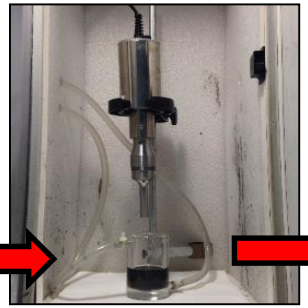
Graphene/ZnO-nanorod nanogenerator in PDMS

Graphene-based sensors for structural health monitoring

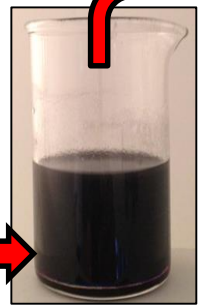


Expanded graphite

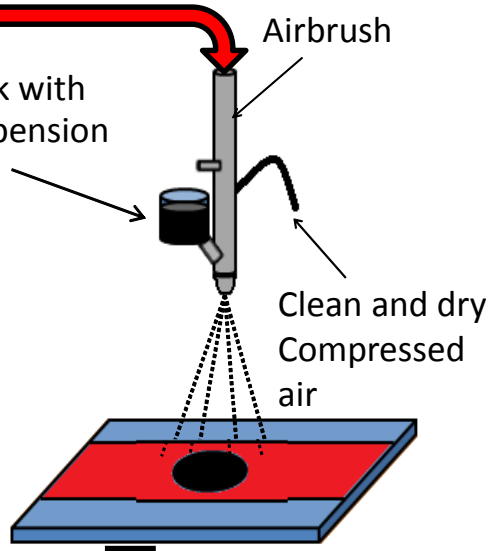




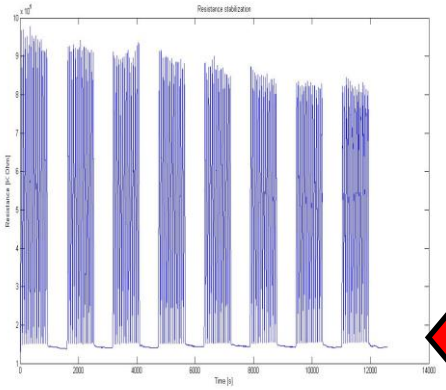
Ultrasonication



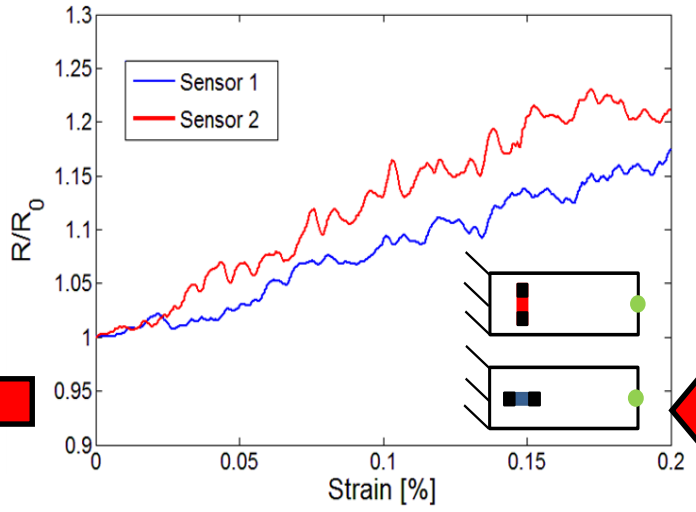
GNP-suspension

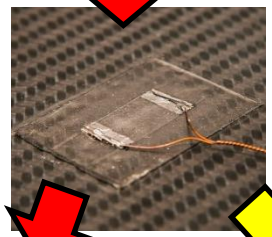


Dynamic response

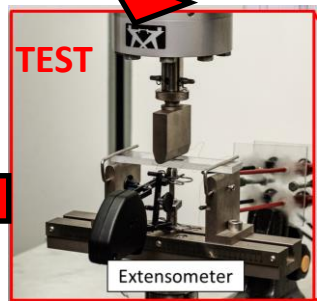


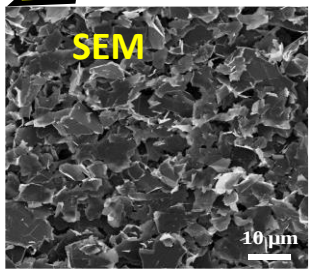
Electromechanical response



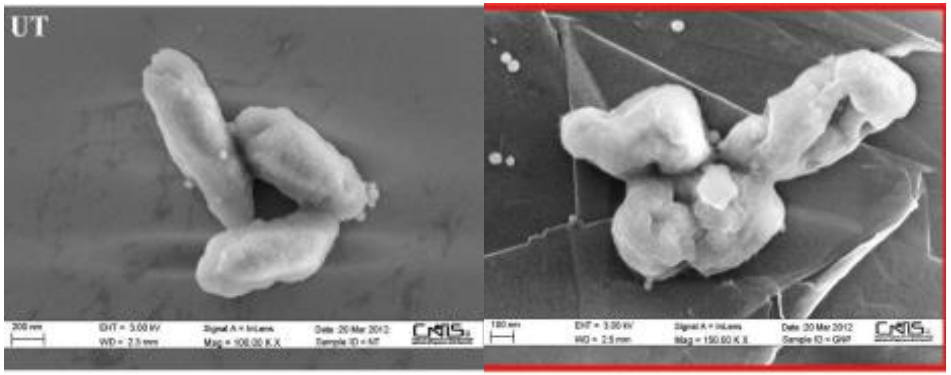


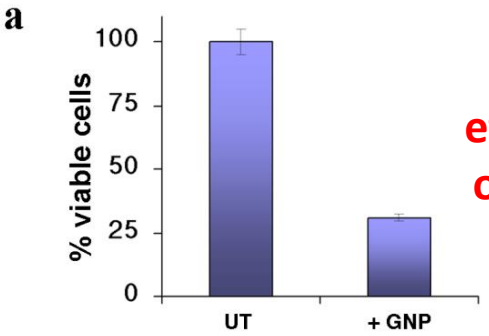
SENSOR



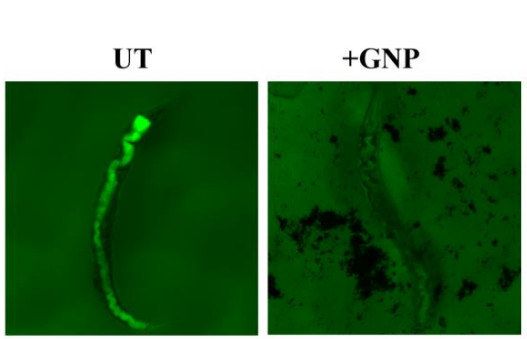


Antimicrobial properties of graphene/ZnO-based nanomaterials

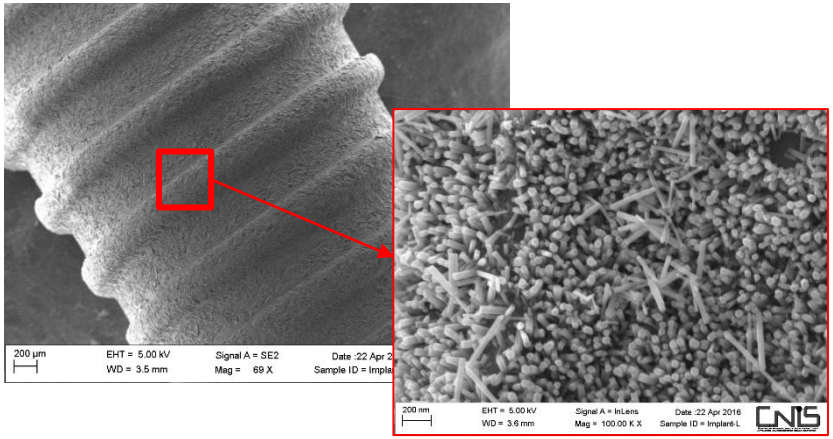




Antimicrobial effect of graphene on gram-negative bacteria

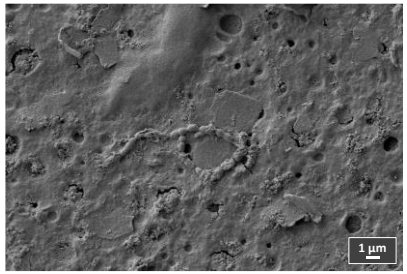


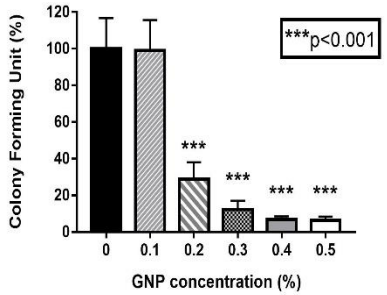
ZnO-decorated antibiofilm implants



Graphene-filled antibiofilm dental adhesive

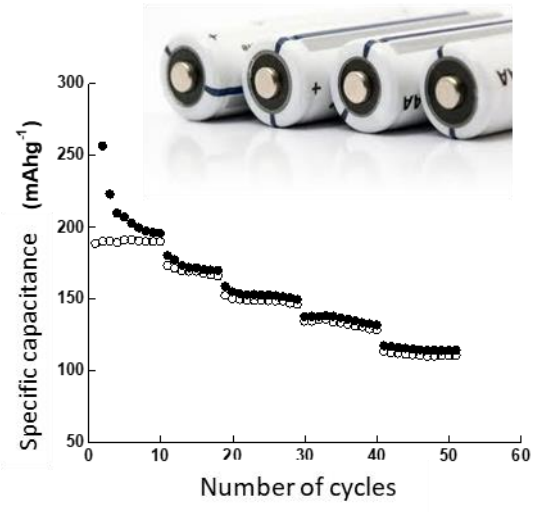
PATENTED *by Sapenza*



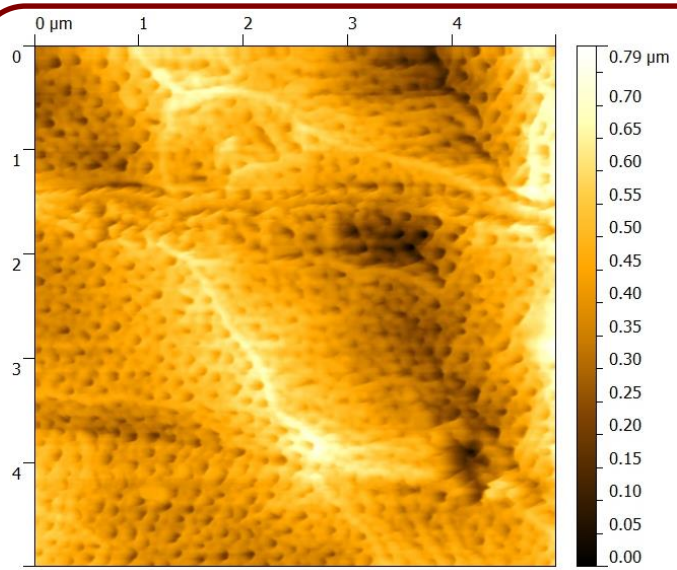


TiO_2 nanotube arrays for energy applications

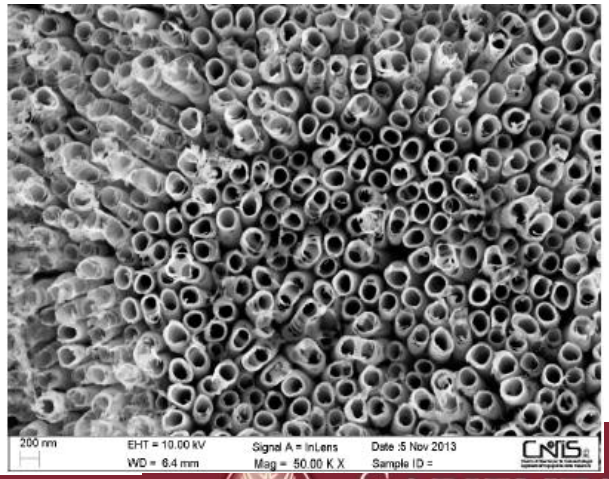
Li-ion Batteries

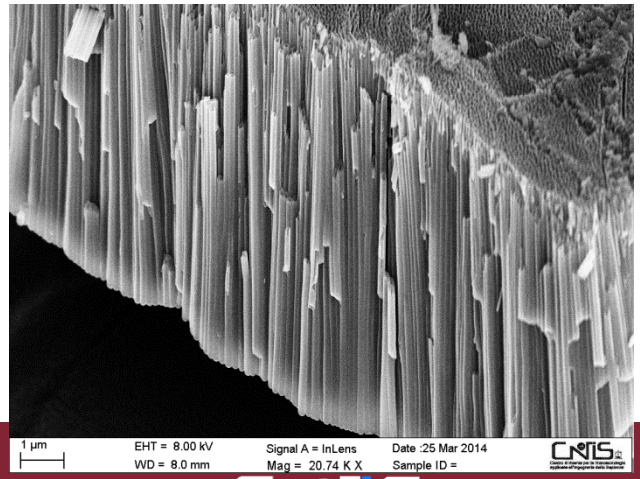


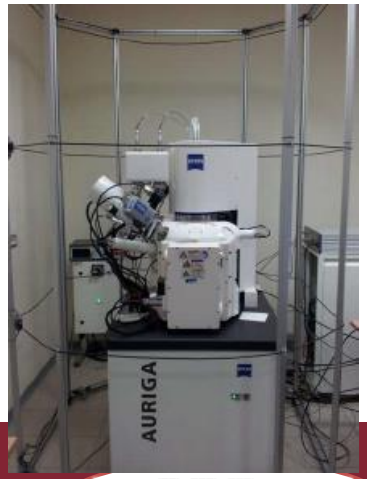
AFM



SEM







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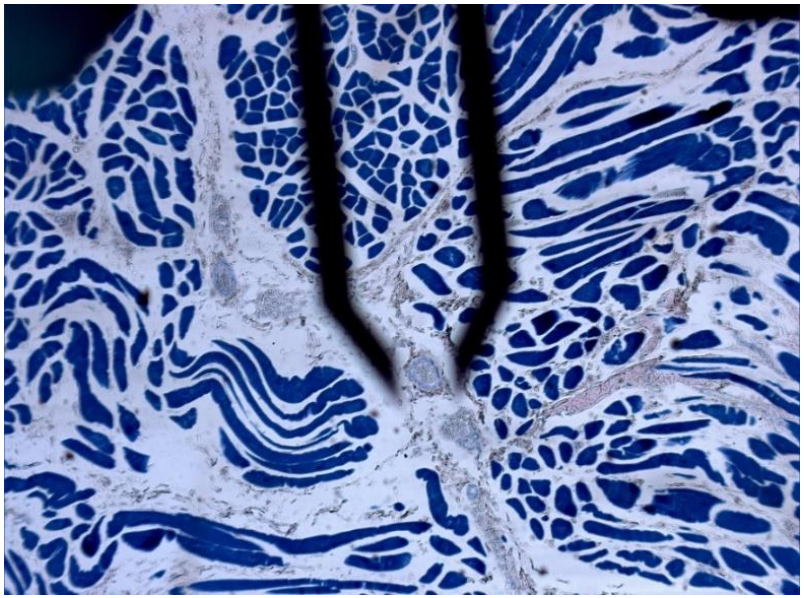
CNIS

SNI Lab

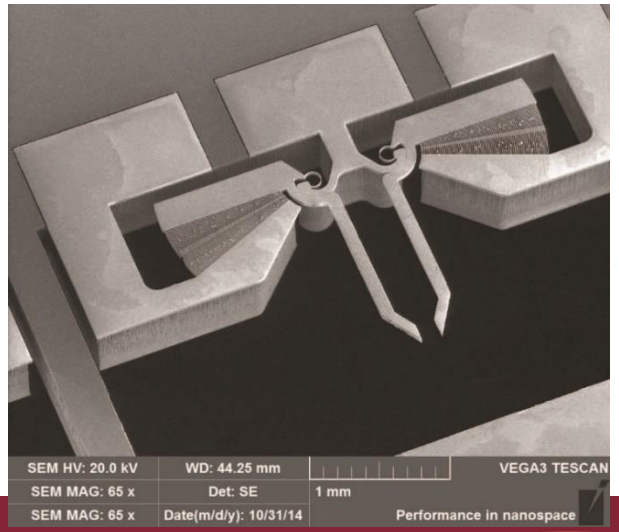
A new generation of **MEMS** integrated smart systems for **4** basic **health** and well-being applications

a) drug delivery,
b) smart surgical tools,
c) cell manipulation
d) diagnosis.



The key challenges addressed:

- Multi-DOF MEMS devices design;
- Built-in sensing, actuation, tools and System Integration;
- Energy harvesting and low-power consumption;
- Biocompatibility.



ATOM Center

Regional Call:

Open Infrastructure for Research

ATOM Project

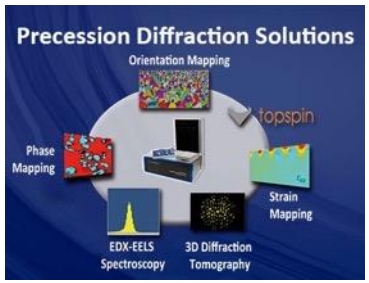
Advanced **TO**mography and **M**icroscopies *(**PI: Marco Rossi**)*

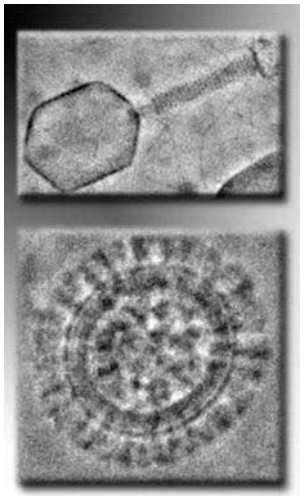
Regione Lazio funded grant: ***2.525.771,16 €*** Total project cost: *3.909.135,23 €*

ATOMCENTER

Obiettivo di TEMIDA: piattaforma multifunzionale per applicazioni multi/inter-disciplinari

1) PRECESSION ELECTRON DIFFRACTION (PED)-based analysis
2) CRYO analysis
3) DIGITAL STEM analysis
4) ENERGY DISPERSIVE X-RAY SPECTR. for compositional analysis





- The JEM-F200 "F2" is the only advanced analytical, high throughput 200kV S/TEM in its class to offer a Cold Field Emission Gun and dual Silicon Drift Detectors.
- The F2 is a multi-purpose workhorse system with advanced and State-of-Art features for non-aberration corrected S/TEM.

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Grazie per l'attenzione

- Prof. Antonio d'Alessandro
- antonio.dalessandro@uniroma1.it