Material Characterization at NanoMicroFAB

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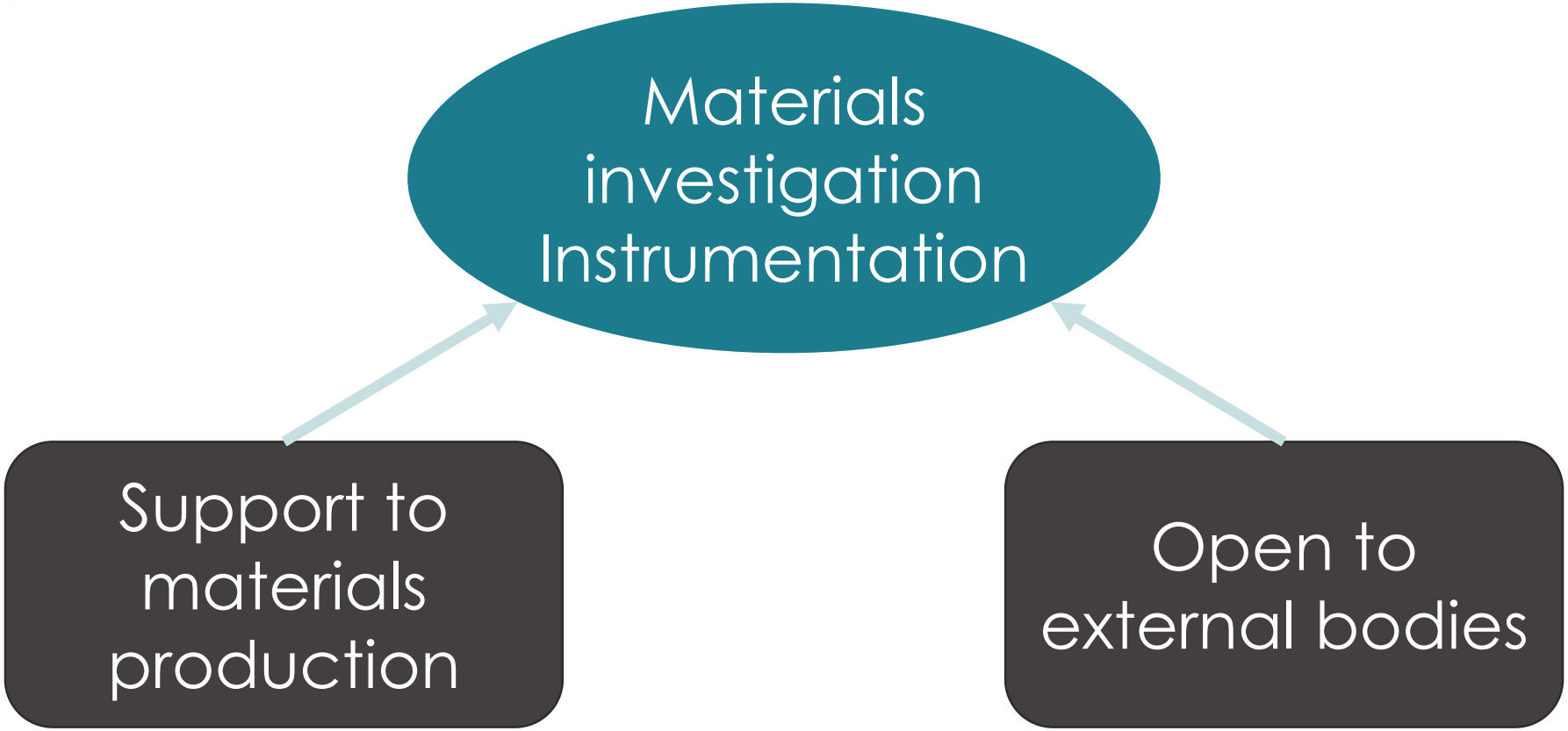
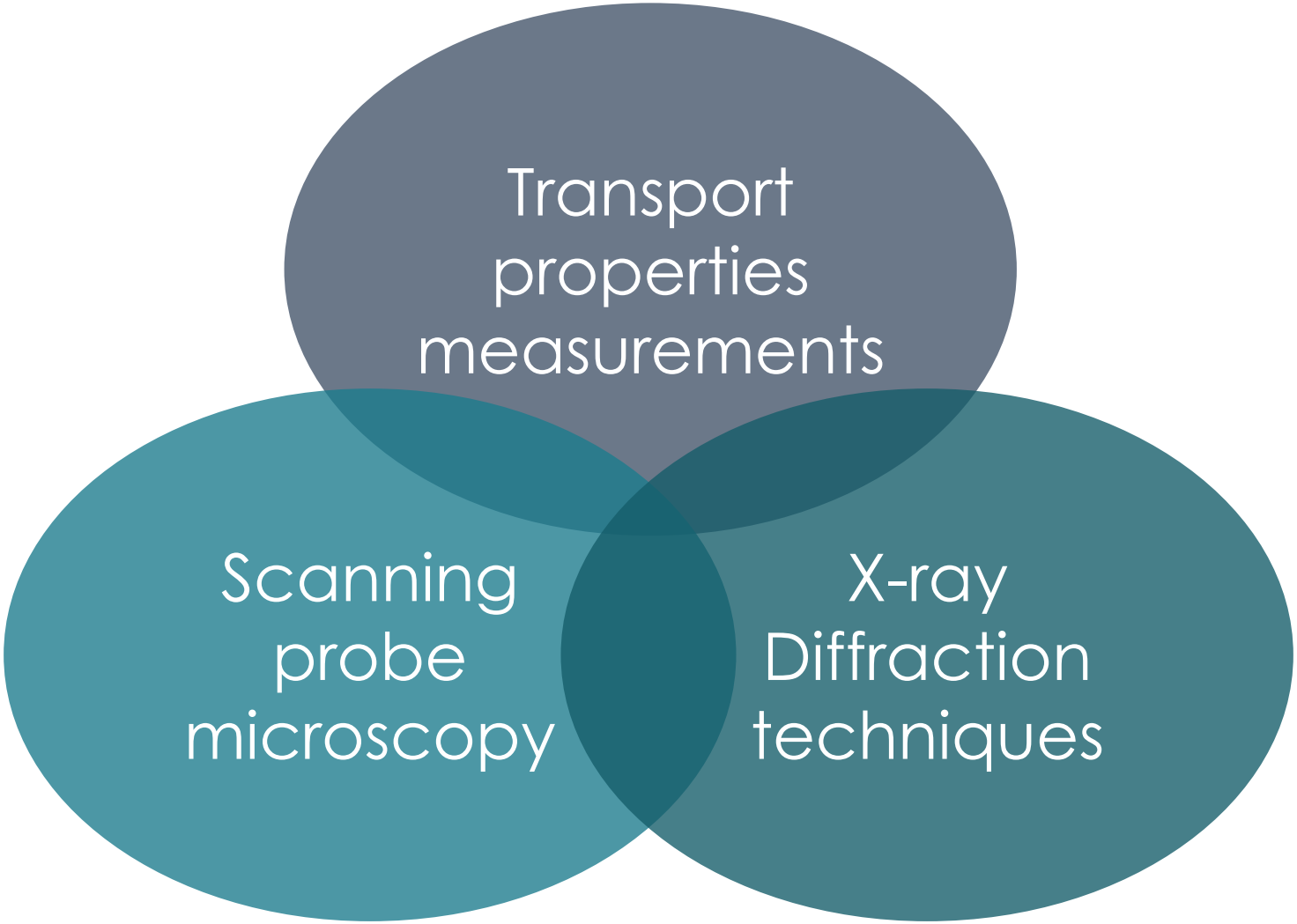
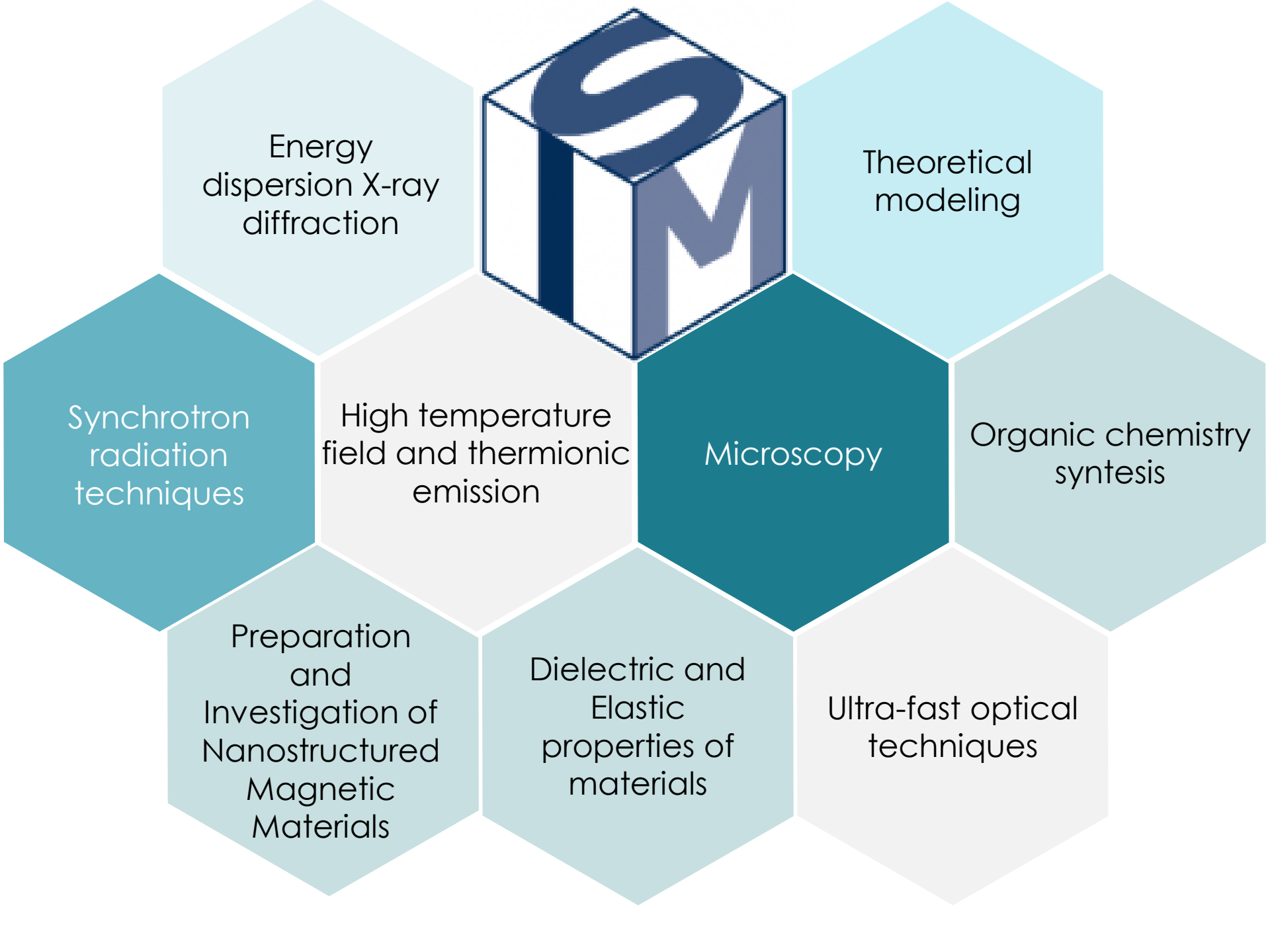
Mission of the Facility

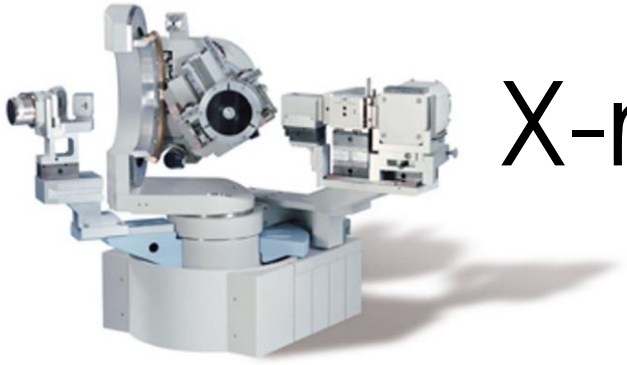
- Supply new materials
- Design, developement, characterization of materials and devices



Instrumentation @ NanoMicroFAB

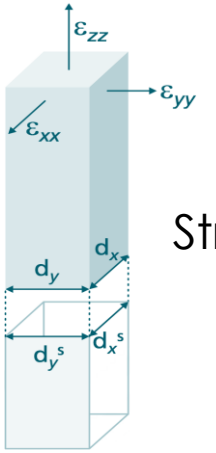



Energy dispersion X-ray diffraction
Theoretical modeling
Synchrotron radiation techniques
High temperature field and thermionic emission
Microscopy
Organic chemistry syntesis
Preparation and Investigation of Nanostructured Magnetic Materials
Dielectric and Elastic properties of materials
Ultra-fast optical techniques



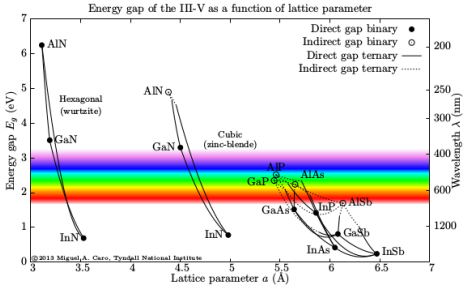
X-ray Diffraction

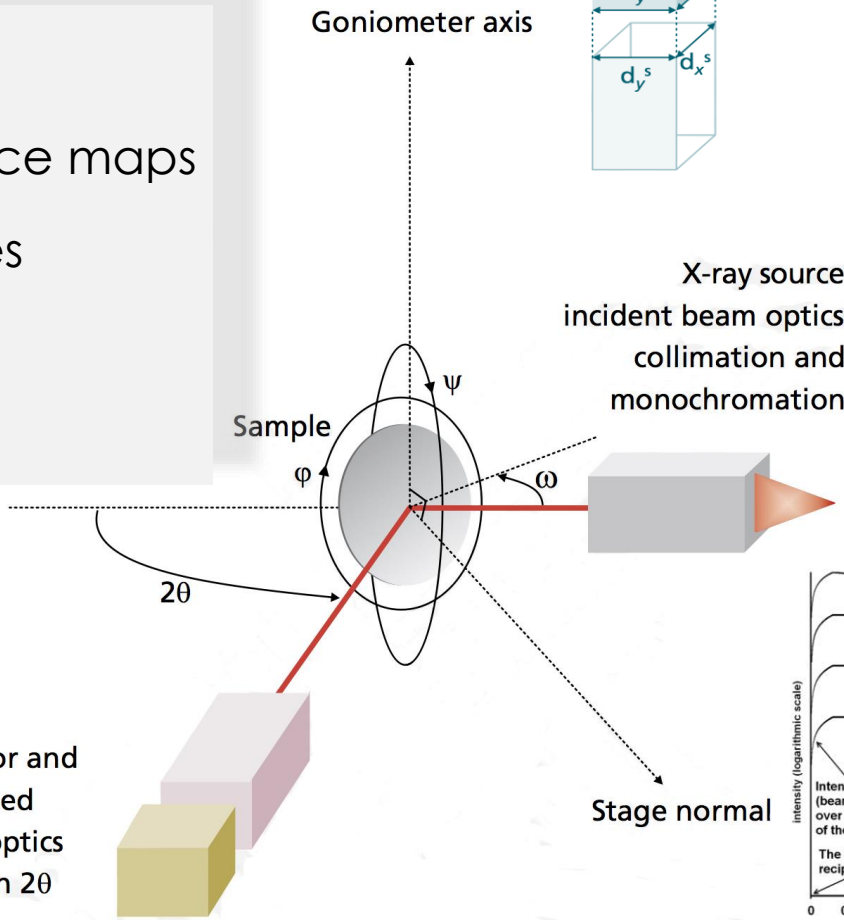
- ω-2θ scans
- Recriprocal space maps
- ω Rocking curves
- X-ray reflectivity

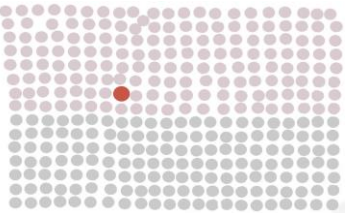


Strain

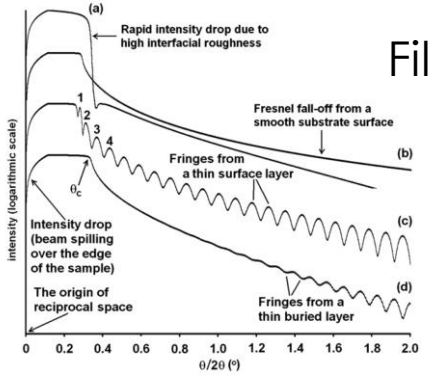
Alloy composition





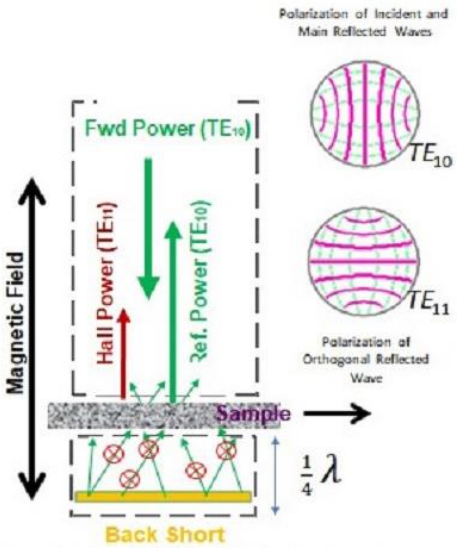


Defects



Film thickness

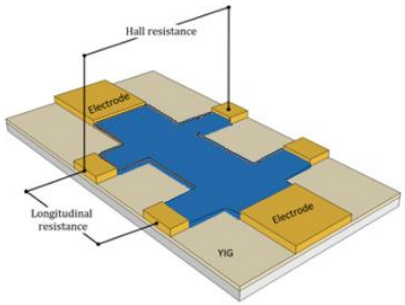
Transport properties



Contactless measurements

Nondestructive determination of carrier concentration and mobility

Electronic properties mapping up to 4" wafers



Magnetotransport

Hall mobility

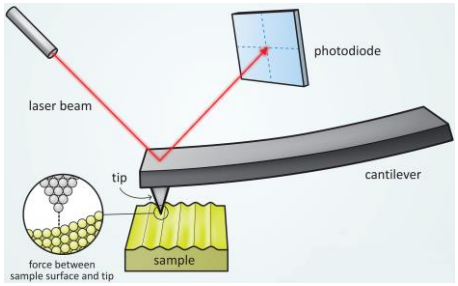
Material resistivity

Contact resistivity

Measurements as a function of temperature

Scanning Probe microscopy

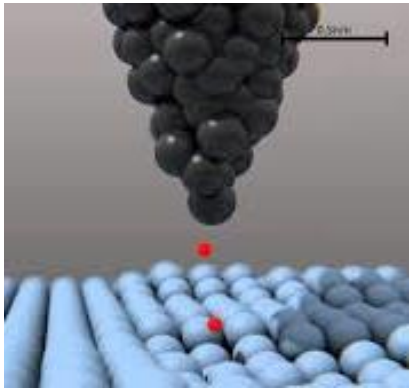
Atomic Force Microscopy



Surface structure morohology

Tribology properties of materials at the micro-scale

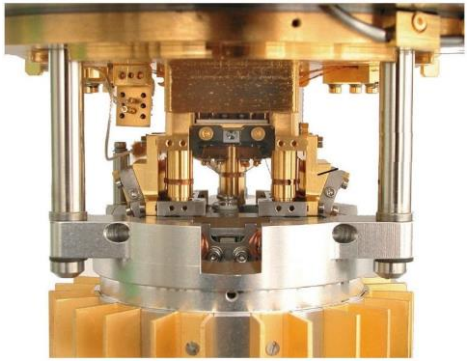
Scanning Tunneling Microscopy



Surface atomic structure

Electronic structure of surfaces and thin films

"*In opearando*" electronic device investigations



Graphene/β-Si_3N_4/Si(111)

A case study: from material to device

Ultra-thin dielectric (ε=6.6) layer on silicon with low density of defects

Prevents silicide formation with most metals used in contact technology

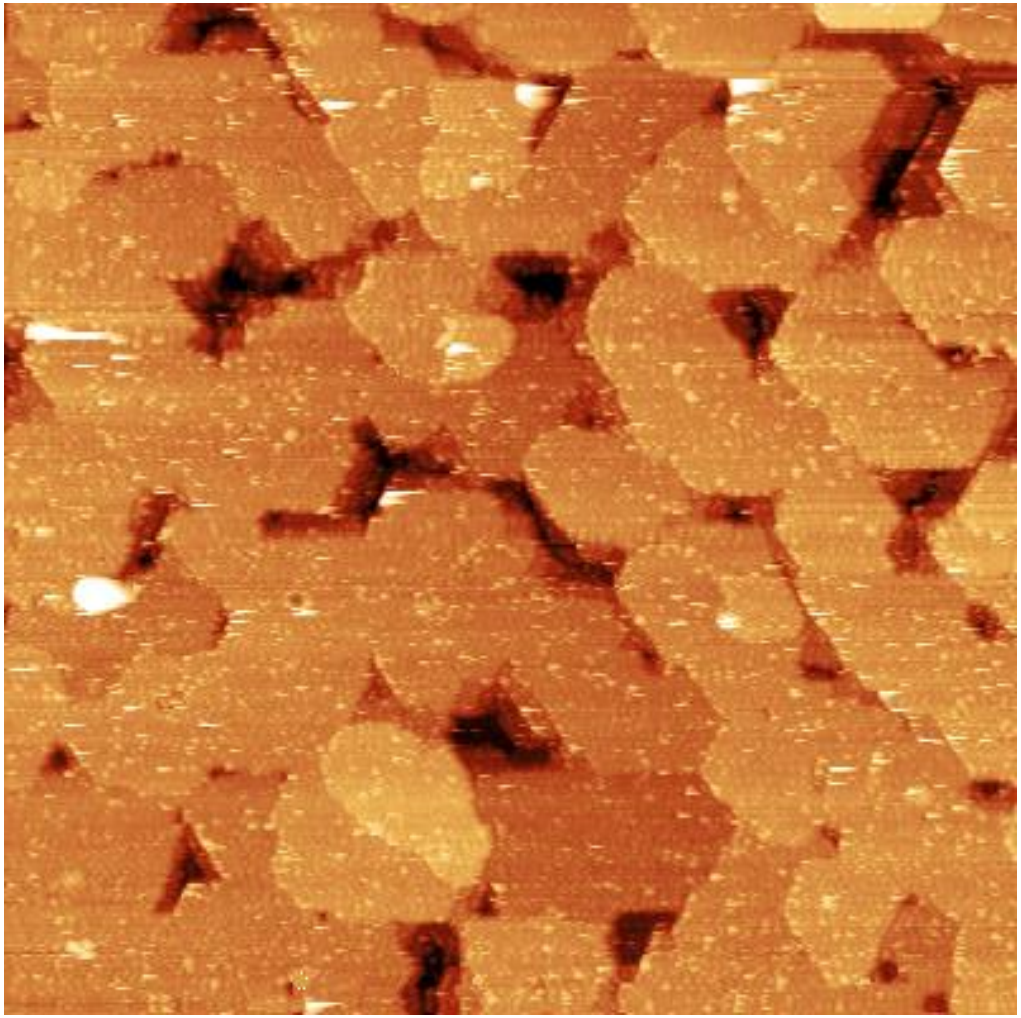
Theoretically predicted to to preserve the elctronic properties of graphene

Process

Clean Si(111) → NH_3 exposure at 700 °C → β-Si_3N_4 (8×8) ~1 nm thick

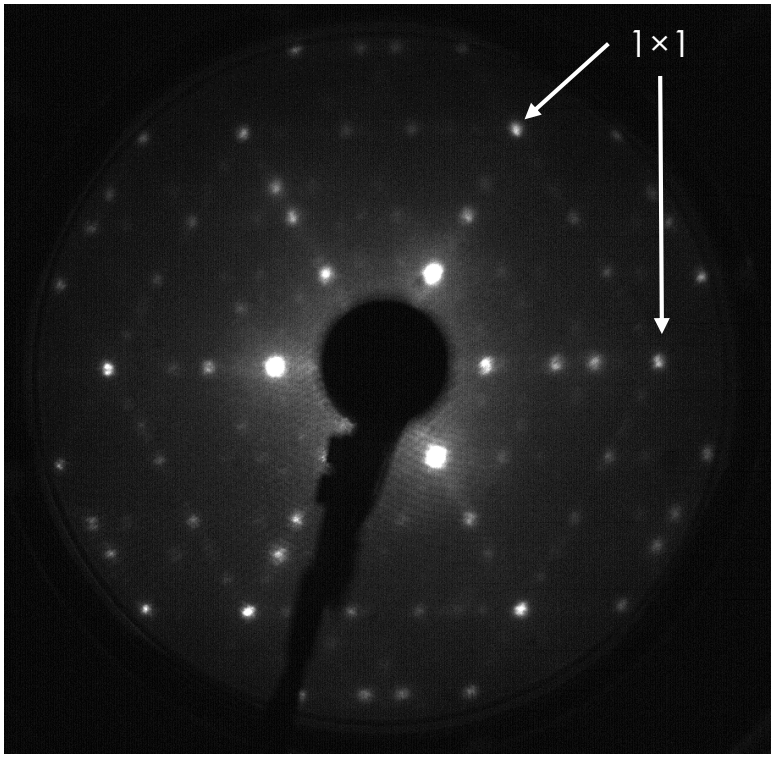
β-Si_3N_4/Si(111) surface structure

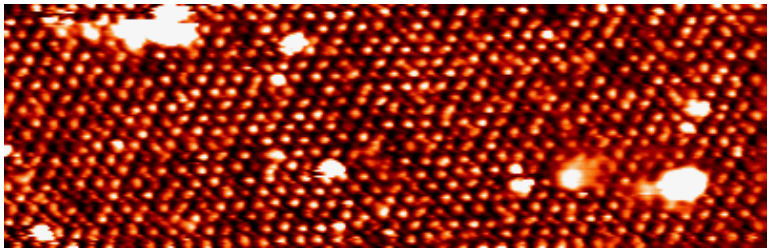
STM image 500x500 nm^2



Roughness 0.503 nm
Grains average diameter ~100 nm

Electron diffraction

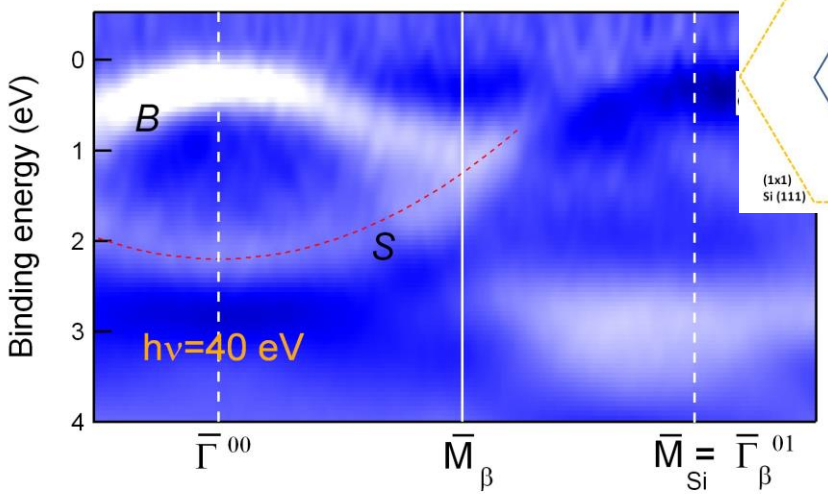


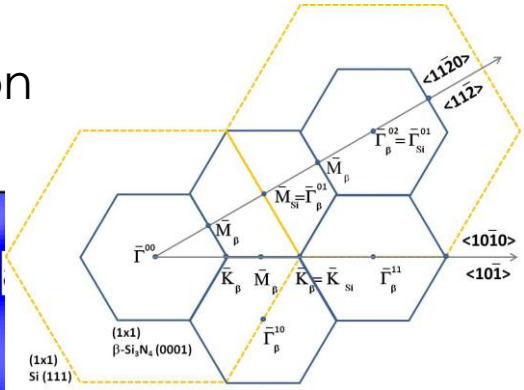


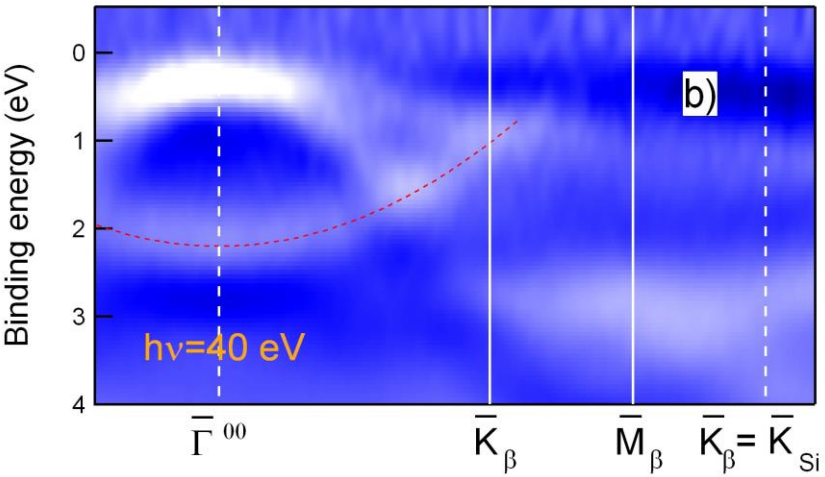
STM image 50x16 nm^2

β-Si_3N_4/Si(111) electronic structure

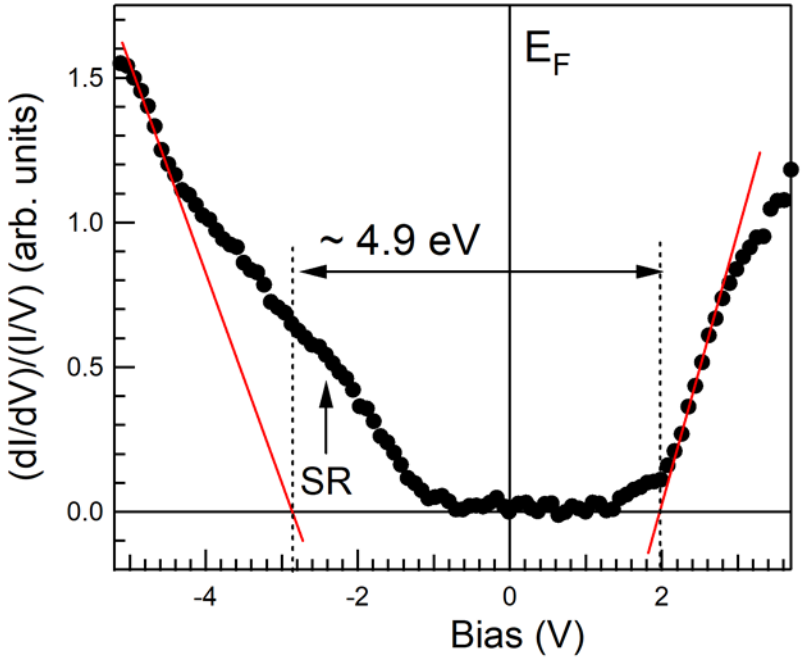
Angle resolved photoelctron spectroscopy







Scanning tunneling spectroscopy



VUV beam line

Elettra Sincrotrone Trieste

Graphene on β-Si_3N_4/Si(111)

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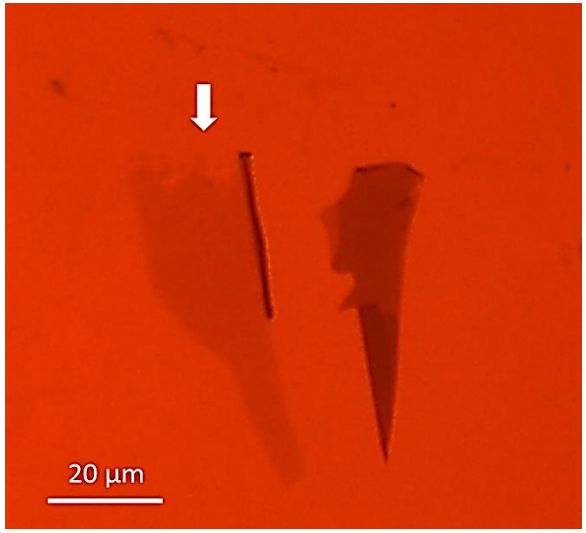
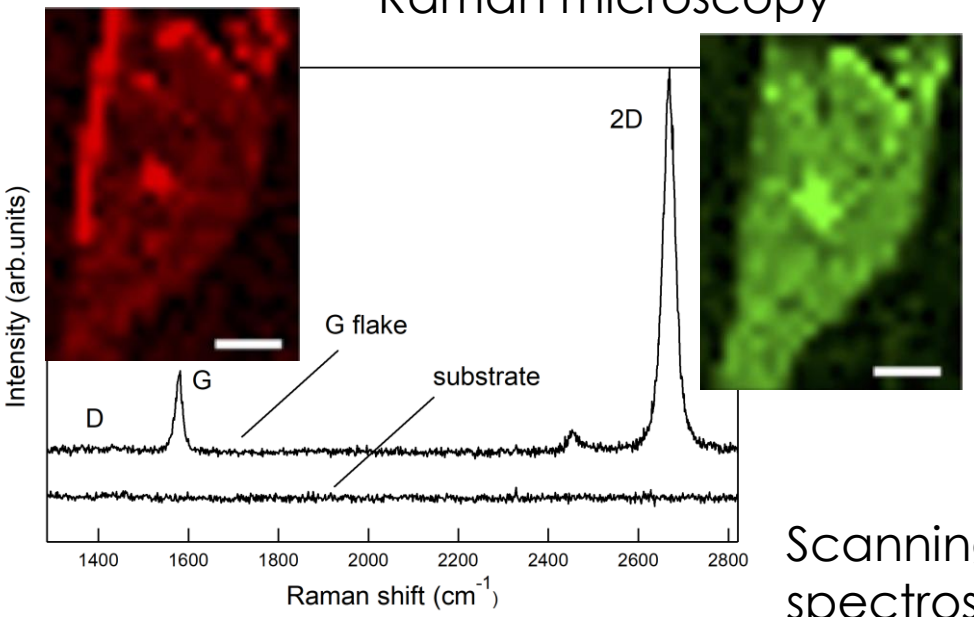
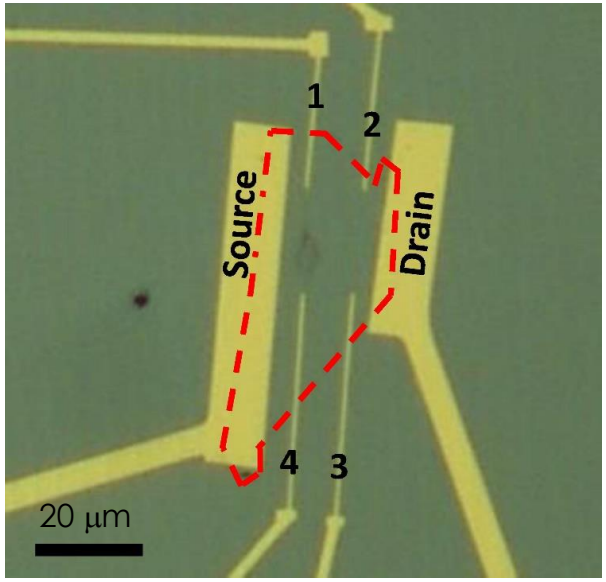
Graphene on PMMA



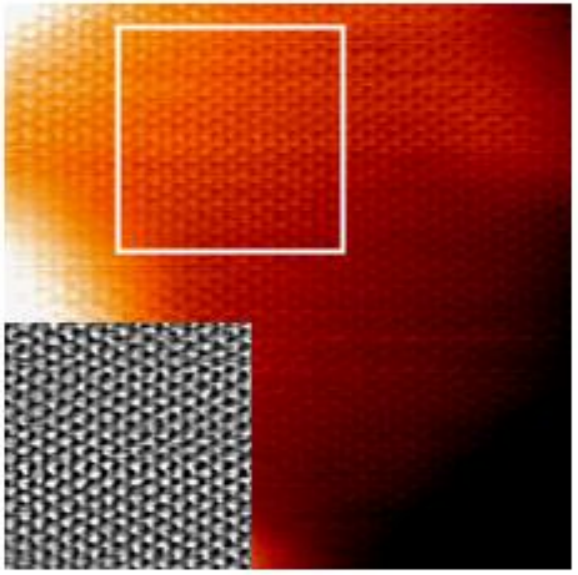
Raman microscopy



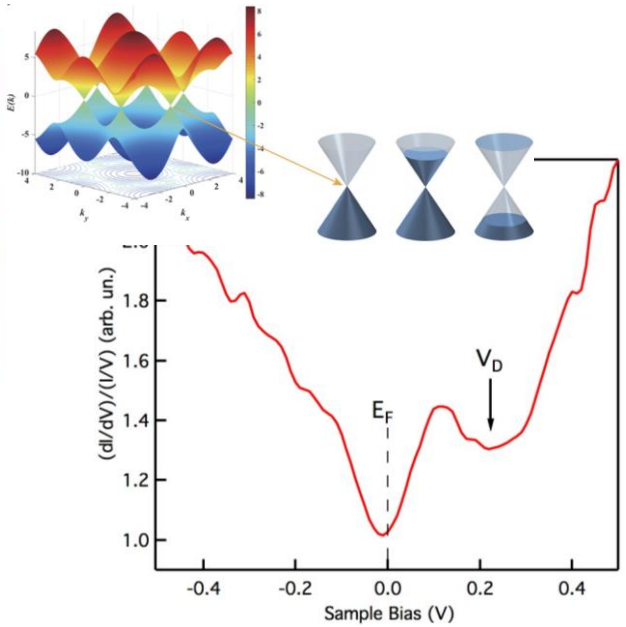
Hall bar device



STM 10x10 nm^2



Scanning tunneling spectroscopy



Magneto-transport measurements

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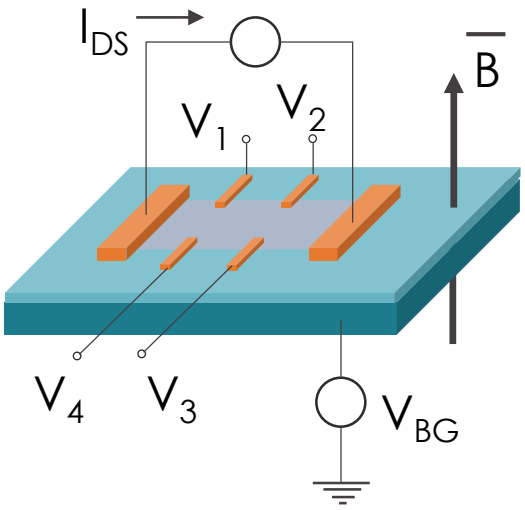
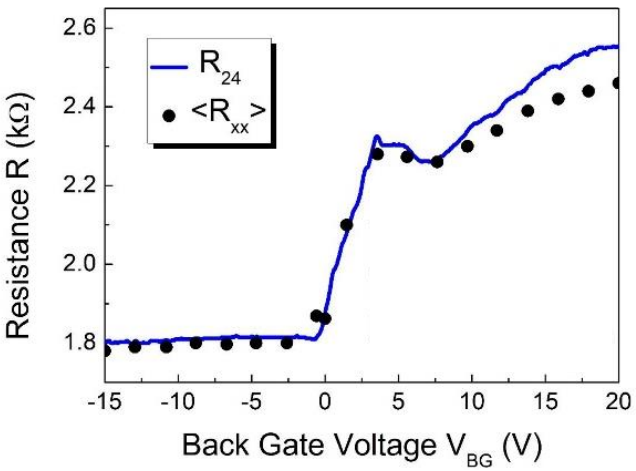
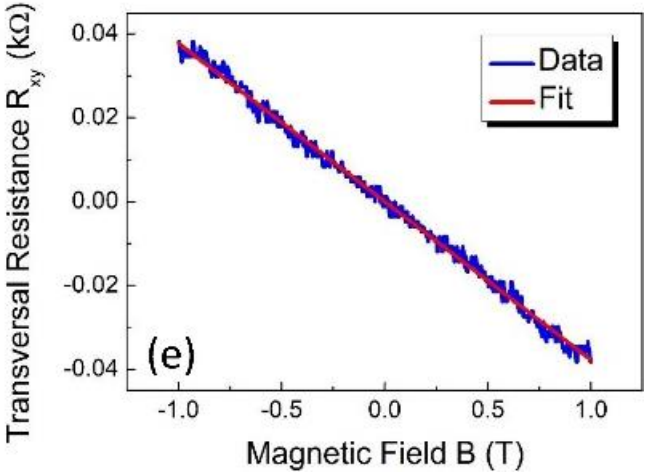
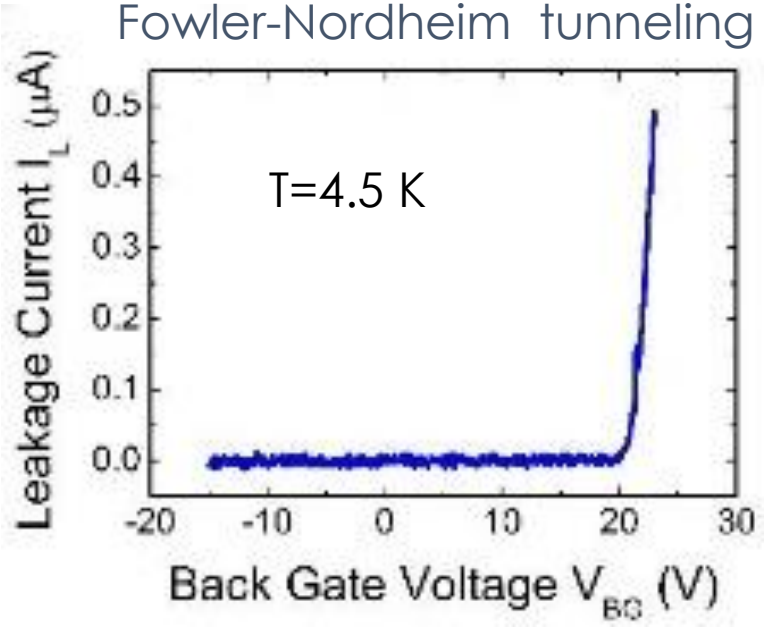




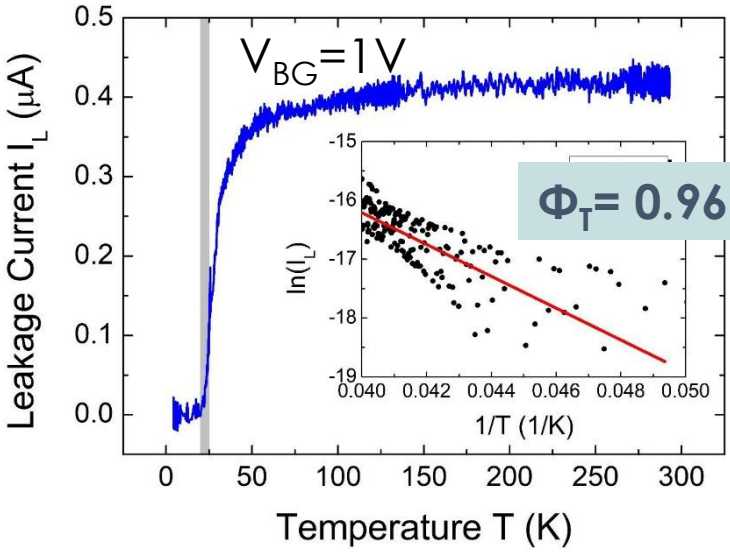


Hole concentration ~$1.6 \cdot 10^{13}$ cm^{-3}
Mobility max 1300 V/cm^2s

Fowler-Nordheim tunneling



Poole-Frenkel tunneling



Φ_T= 0.96 eV

NanoMicroFAB has a state of the art instrumentation for materials investigation:

support for material production

open to external users

Innovative R&D projects can be developed in collaboration with CNR institutes thank to a broad characterization instrumentation