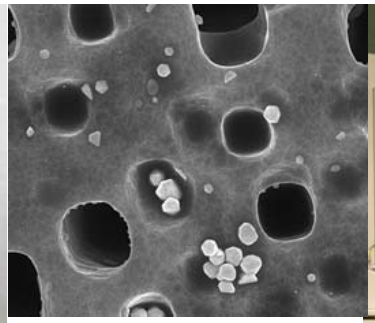


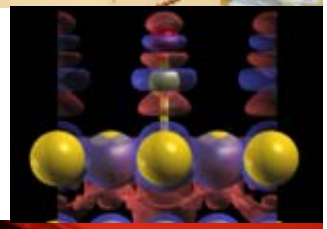



# Accesul firmelor la facilitati experimentale

## *Facilitatea IMT-MINAFAB*

**Acad. Dan Dascalu, Dr. Radu Popa**
***INCD-Microtehnologie***

National Institute for R&D in Microtechnologies
126A, Erou Iancu Nicolae, 077190, Bucharest, Romania
Tel: +40 21 269 07 78
Fax: +40 21 269 07 72
**www.imt.ro - www.imt.ro/MINAFAB**




# Scopul prezentarii

- Dotarile experimentale achizitionate in ultima vreme in Romania in institutiile publice reprezinta si o sansa a firmelor de a avea acces la o baza experimentala moderna;
  - Este vorba in primul rand de IMM-urile inovative, cu posibilitati reduse de a investi in echipamente; exista situatii in care si firmele mari (inclusiv transnationalele) sunt interesate;
  - Fondurile structurale permit si sustinerea investitiilor in firme;
  - *Exista un sistem larg folosit in alte tari (v. mai departe);*
- Pentru ca firmele sa aiba acces la dotari, **trebuie creat un sistem** de utilizare a echipamentelor; este necesara si o “cultura de organizatie”;
  - Practica uzuala in Romania este aceea ca echipamentele sunt utilizate exclusiv de catre laboratoarele (colectivele) care le poseda;
  - Utilizatorul (unic) al echipamentului isi ofera serviciile contra participarii ca partener in proiecte CD sau pur si simplu pentru a deveni coautor la o lucrare …..
- INCD-Microtehnologie (IMT-Bucuresti) prezinta experienta proprie in crearea centrului IMT-MINAFAB (**IMT** centre for **MI**cro and **NA**no**FAB**rication), www.imt.ro/MINAFAB

# Experienta internationala

- Un SUA, Anglia si alte tari exista centre experimentale “deschise” de nanotehnologie, respectiv de micro-nanotehnologie la care au acces si firmele;
- In acest fel firmele pot utiliza echipamente deosebit de costisitoare, dincolo de posibilitatile lor curente de achizitie;
  - Atunci cand echipamentele sunt folosite in centre de cercetare exista si o expertiza in utilizarea acestora, inclusiv tehnologii noi de fabricatie, care pot fi utilizate de catre firme in realizarea unor produse inovative;
  - In alte situatii firmele au propriile idei si doresc acces direct la echipamente, fara a divulga elementele de proprietate industriala pe care vor sa le foloseasca;
- In unele cazuri firmele inchiriaza echipamente in astfel de centre, folosindu-le in exclusivitate, printre altele si pentru furnizarea de servicii la terti;
  - Centrele experimentale (de obicei din universitati), care nu dispun de fonduri suficiente pentru asigurarea functionarii, sunt gata sa inchirieze unele dotari ……..

# Despre IMT-MINAFAB

- O vasta zona tehnologica (inclusiv parte de caracterizare) a fost pusa in functiune incepand din septembrie 2008 (o noua “camera alba”);
- IMT-MINAFAB (**IMT** centre for **MI**cro and **NA**no**FAB**rication) a fost inaugurata oficial in aprilie 2009 (prezentare la Bruxelles, mai 2009); in prezent este folosita de cateva firme; in paralel au loc activitati de cercetare si educative;
- Prezentarea extensiva a informatiei legate de dotari si servicii apare la adresa www.imt.ro/MINAFAB
- Facilitatea a fost caracterizata dpdv al functionalitatii si asigurarea calitatii (acreditare in scurt timp)
- O extindere va avea loc in saptamanile urmatoare (o noua zona de camera alba, cu echipamente de micro- si nano-fabricatie; investitiile continua pana in 2013 (finantare din fonduri structurale)

# “Filozofia” facilitatii experimentale “deschise”

- De ce este IMT promotorul unor astfel de facilitati experimentale (centru “deschis”, inclusiv pentru firme)? Un sistem “deschis” permite valorificarea mai buna a “activelor” organizatiei (atat “tangibile”, cat si “intangibile”);
  - Echipamentele sunt utilizate mai eficient;
  - Experienta oamenilor, parteneriatele etc. sunt si ele mai bine utilizate
- Trebuie formata *o noua cultura de organizatie*: sistemul “deschis” trebuie sa functioneze mai intai in raporturile dintre colectivele CD din institut;
- *Sistemul deschis de inovare*: clustere de mari proportii in Europa si in Asia; esential pentru raporturile cu industria
- In Europa exista **EUMINAfab**, un consortiu de organizatii de cercetare, extrem de puternice, care colaboreaza in asigurarea unui sistem de servicii de micro- si nanotehnologie pentru cercetare si pentru industrie
  - O tentativa de a forma o retea care sa asigure servicii a existat si in Romania

# “Matricea” de colaborare

- “Matricea” de colaborare coreleaza:
  - Tipurile de beneficiari (in sens larg acestia sunt “colaboratori”);
  - Tipurile de servicii.

- Beneficiarii sunt:
  - Din cercetare-dezvoltare;
  - Din educatie;
  - Din industrie.

- Tipurile de servicii (in sens larg) sunt:
  - Colaborari propriu-zise (furnizorul si “clientul” lucreaza impreuna);
  - Servicii propriu-zise (lucrezi pentru client pe echipamentul tau):
  - Asigurarea accesului direct (clientul lucreaza pe echipamentul tau)

# Collaboration matrix

| | **Partnerships** in RTD activities, sharing the IP resulting from research | Scientific and technological **services**, including design and consulting | **Direct access**, "hands-on" activities (after proper training) |
|---|---|---|---|
| **Research groups** outside IMT-Bucharest | - usually financed by a contract of partnership agreement. | - typically, specific activities will be performed by IMT-Bucharest as a subcontractor (technological processes, analysis and characterization, design and simulation, etc.) with no IP rights. | - direct access of researchers from partner organizations, as part of common RTD. |
| **Educational** bodies for Ph.D. and postdoctoral studies, M.Sc. studies, "hands-on" training etc. | - supported by individual grants or following an agreement with universities, specifying the cost and intellectual property issues. | - occasionally. | - as part of a common research activity, or providing training on a commercial basis. |
| **Companies** (Industry) | - based on special NDA and IP agreements. | - services provided on commercial basis. | - companies may use their own IP rights. |

# About IMT-MINAFAB, in brief

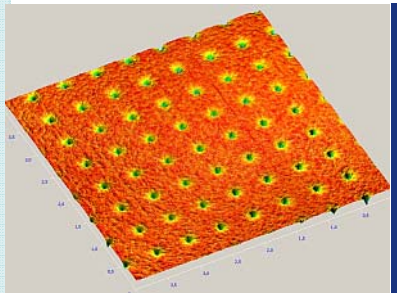
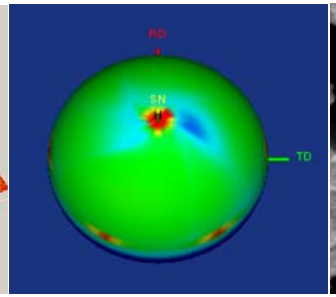
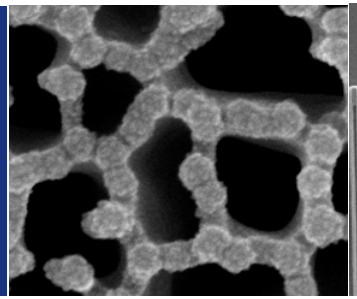
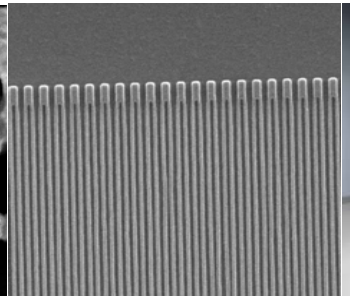
- State of the art research facility, operating since September 2008.
- Center of services for micro-nanofabrication and platform of interaction as open-centre for research and education-by-research, focused on multidisciplinary innovation and knowledge transfer to industry.
- Enables highly efficient exploitation of IMT's existing tangible and intangible assets in nano-science/technologies: clean-room facility, advanced equipments, multidisciplinary knowledge and experience, partners and clients.
- Complex technological platform: CAD tools, mask shop sector, analysis and characterization, nanobio fabrication, reliability tests.
- Access is facilitated in a variety of ways, with notable accent on developing common R&D projects and on offering direct access of innovative companies to nanoscience and nanotechnology expertise and tools.

# Main facts, main figures [1]

- Class 1000 clean room (220 sqm) for the mask shop and the most demanding technological processes.
- Class 100,000 clean room - so called "grey area" - (200 sqm), mostly for the characterization equipments.
- Class 10,000 clean room (120 sqm) for thin films by CVD techniques, RTP, etc. (to become operational).

- Accumulated total investment in equipments and infrastructure: about 9 M euro (2006-2009: 7 M euro; 2008: 3.5 M, mainly from Capacities projects).

- Large range of services. Main categories:
  - micro/nanofabrication for devices and systems
  - inspection, analysis and characterization of surfaces, films, crystals, nanostructures
  - design, modeling and simulation
  - complex RDI services - from design, to reliability testing


# Main facts, main figures [2]

- Over 60 national users as partners in consortia, or based on bilateral agreements: 30 companies, 15 research institutes, 15 universities.

- Over 30 industrial users, as partners in consortia or contracted service users: Austria(1), Finland(1), France(1), Germany(8), Greece(1), Hungary(2), Italy(3), Poland(1), Slovakia(2), Spain(1), Sweden(6), The Netherlands(3), etc.

- Over 30 partners in research - FP6-7, bilateral projects: Belgium(2), Finland(1), France(2), Germany(11), Greece(1), Hungary(1), Italy(2), Ireland(1), Israel(1), Poland(1), Spain(1), The Netherlands(3), UK(1), Singapore(1), etc.

- Master courses and hands-on training for students of Polytechnic University of Bucharest. A soon-to-be-financed POS-DRU project will ensure access for up to 35 pos-doc positions, including in MINAFAB.

- Operation of IMT-MINAFAB conforms with best technical/technological/ management standards: degree of decontamination, safety of operation and processes, equipment conditions and operation, access monitoring




# Main facts, main figures [3]

- Accumulated funding based on:
  - three projects for technological networks (2005-2008) - NanoScaleLab and NanoBioLab labs created in this context: nuclei of some current experimental labs .
  - four infrastructure projects (2006-2008) - extension of capabilities.
  - eight infrastructure projects from the “Capacities” programme (2007-2009) - five of them consolidated the “Centre of nanotechnologies”; reconstruction/updating of the premises.
  - MIMOMEMS project of centre of excellence, funded by the EU.
  - Various research projects in national programmes.
  - Individual themes of research in the “core programme”.

- Result:
  - IMT-MINAFAB as an integrated cluster of new experimental laboratories initiated and operated by multidisciplinary research groups. Other equipments that can be used for production (mask shop, wafer processing etc.) are managed by execution personnel, in a dedicated department.

  - Provides the experimental support for a number of interdisciplinary groups, such as:
    - **Centre of Nanotechnology** (CNT-IMT) under the aegis of Romanian Academy.
    - **MIMOMEMS Centre of Excellence** from IMT (RF and Opto MEMS), EC 2008-2011.
    - **LEA (Associated European Laboratory)** “Smart MEMS”, IMT-Bucharest in association with LAAS/CNRS, Toulouse (France) and FORTH, Heraklion (Greece).

  - Facility providing state of the art services in micro-nanotechnology and hands-on education and training.

# Major fields of R&D

- Collaborative multidisciplinary research, focusing on convergent micro-nano-bio technologies, based on **structuring and characterization at the nanoscale**.

- Components for nanoelectronics, photonics and microwaves
  - new fabrication technologies in Si, as well as in wide bandgap semiconductors, dielectrics, polymers.
  - CNT/graphene-based nanostructures for nanoelectronics (transistors and chip interconnections).
  - new concepts and structures for optical MEMS and RF-MEMS.

- Advanced nanomaterials and nanostructures for therapies, biosensing, energy and other industries
  - functionalized nanoporous materials, nanocomposite particles, microarrays.
  - nanocomposite and film assemblies for fuel cells and photovoltaics.
  - SAM's, immobilization and combined studies of molecular interactions.
  - microfluidic components and biochips for biosensing and monitoring.
  - functional films and nanocomposites for: neurosensing, constructions.

# Major fields of R&D

- New technologies for fabrication and characterization
  - nanolithography, mask-free nano-connections, high aspect-ratio nanostructures.
  - silicon nanoelectrodes, functional porous silicon, bio-active materials, field emission nanostructures.
  - soft-lithography and replication.
  - rapid prototyping: dip-pen nanolithography, laser micromachining, 3D and inkjet printing.
  - nanomechanical characterization of materials.

*IMT-MINAFAB currently provides a complex technological platform for fundamental research, application-oriented R&D and even small-scale production.*

# Equipment overview [1]

- Main tool categories:
  - lithography – chrome, maskless, nano
  - 4-6” processes – e-beam induced, physical/chemical depositions, thermal...
  - characterization and testing – electron/contact/X-ray/UV/Vis/NIR /chemical/mechanical/electrical/thermal
  - CAD and simulation – coupled analysis, M(O)EMS, RF-MEMS, microfluidics...

Equipment overview

## Pattern generator for mask manufacturing
## *DWL 66 fs*
## Heidelberg Instruments Mikrotechnik, Germany

Mask manufacturing for all semiconductor applications
Minimum pattern : 1µm

Direct writing - HeCd 442-nm laser - (wafers, different substrate types) using various photosensitive coatings (positive and negative resists, SU8, photosensitive polyimide)

-3D structuring in thick photosensitive materials

Equipment overview

## Dip Pen Nanolithography Writer
## *NSCRIPTOR*
## NanoInk, Inc., USA

Scanning probe lithography technique for patterning in nanometre range.

Direct writing method that can use molecular and biomolecular “inks” on a variety of substrates: polymers, sol-gel precursors, nanopowder, complex molecules, quantum dots etc.

Pattern width down to **30 nm**.

## RIE Plasma Etcher
## *Etchlab 200*
## SENTECH Instruments, Germany)

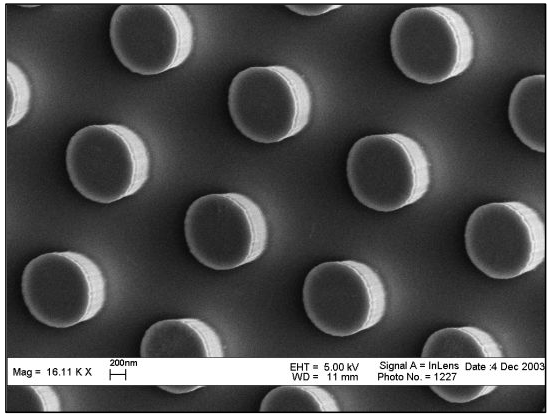
**Conventional and non-conventional processes:**

- **Etching:** Si, SiC, SiO2, polySi, Si3N4, TiO2, SU8, PDMS, PMMA

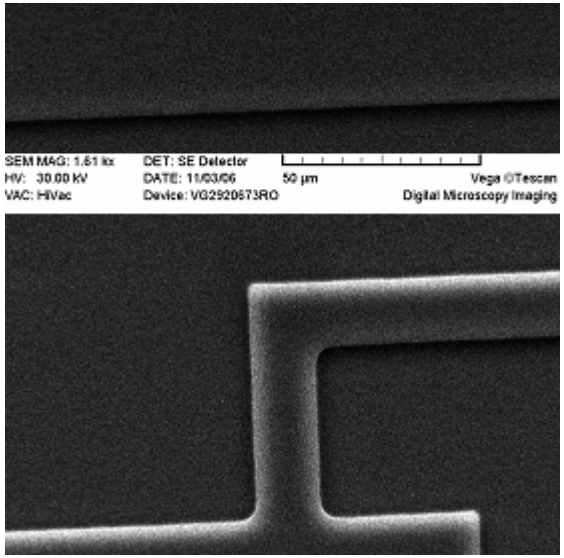
- Physical-chemical reactions at room temperature for the **modification of the surfaces** (contact angle, superficial polymerization, hydrophilic and/or hydrophobic surfaces).

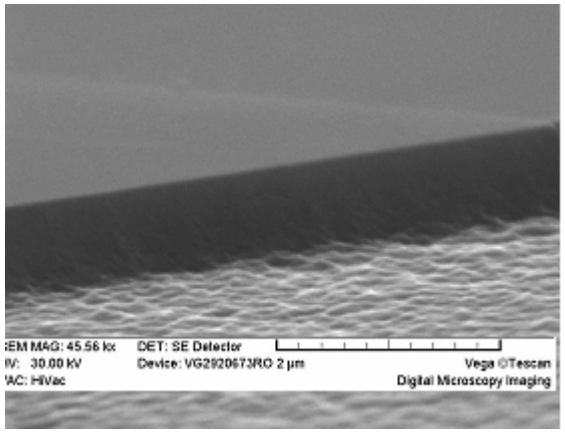
- Plasma RF treatments for **improving the substrate adherence.**

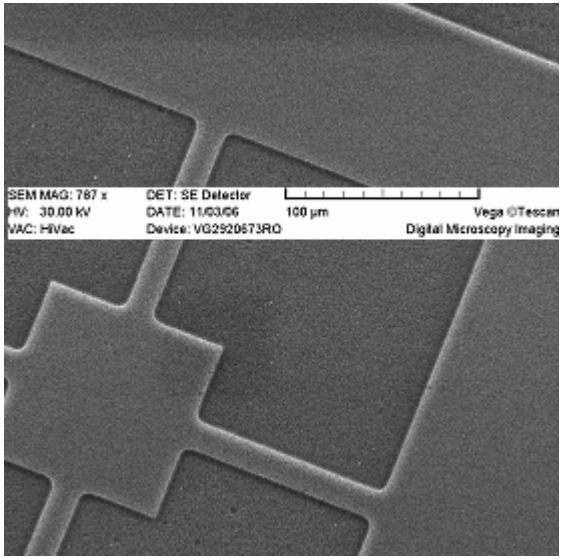
# Using RIE in micro- and nanophotonics




III-V quantum dots. The PL and Raman responses confirmed negligible damage during the etching process




Fresnel mirrors obtained by plasma etching of silicon and silicon dioxide

Equipment overview

# Electron Beam Evaporation and DC sputtering system
## *AUTO 500*
## BOC Edwards, UK

Film deposition processes:
- **DC sputtering**
- **e-beam evaporation**

Chamber size: 500mm x 500mm

Coating materials: Al, Ni, Cr, Au, Pt, Ti, W, etc

Up to 6 coatings in a single vaccum process (4 e-beam, and 2 sputtering)

Resolution: 0.1nm

NanoScale Lab

# Electron beam lithography and nanoengineering workstation *e_Line* Raith, Germany

- **high resolution FE SEM**
- **direct writing Electron Beam nanoLithography (EBL)**
- **nanomanipulation: e-beam induced deposition (EBID), e-beam induced etching (EBIE)**

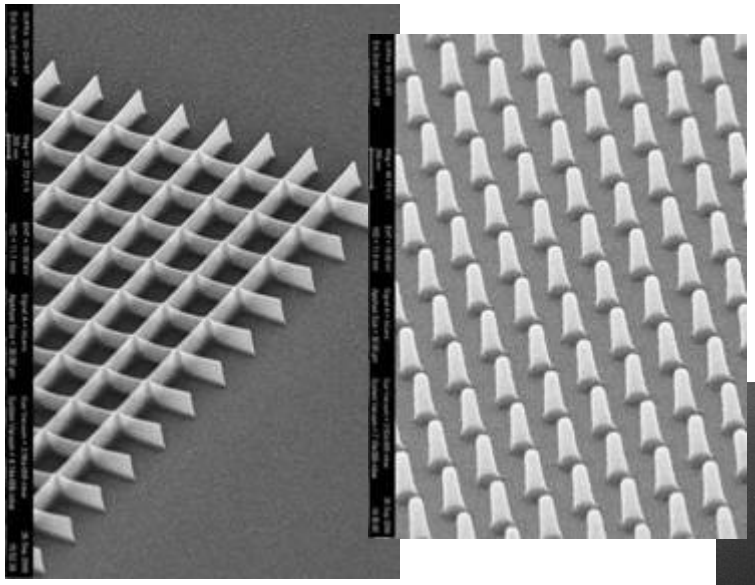
**Stage:**
laser interferometer;
100mmx100mm;
2nm resolution

**Minimum line width**:
10-20nm

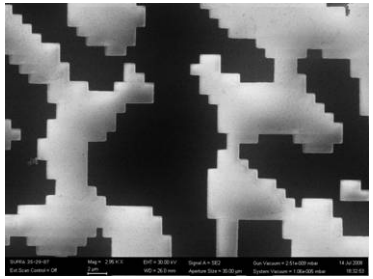
**Stitching accuracy**:
40nm

NanoScale Lab

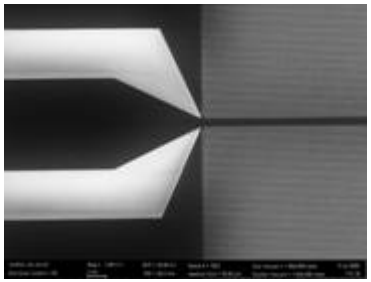
## High aspect ratio (12:1) structures in PMMA

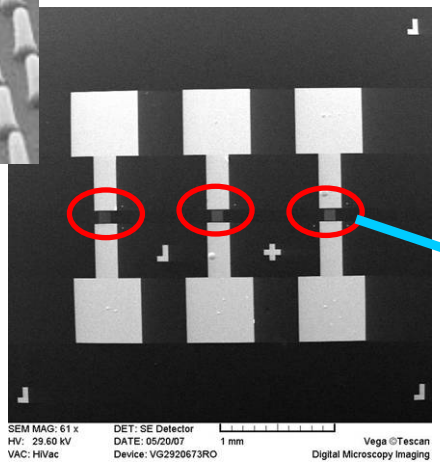


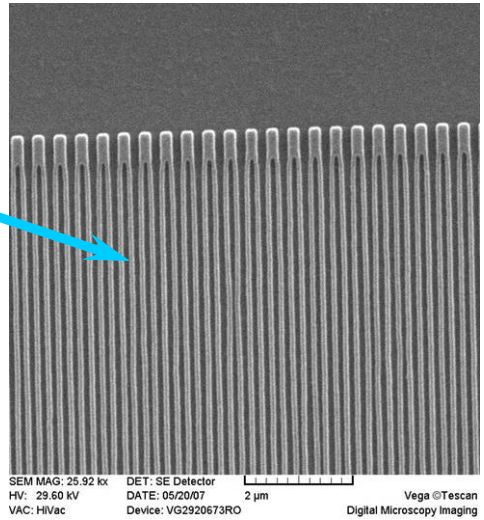
*Diffractive Optical Element (DOE) for photonics applications*

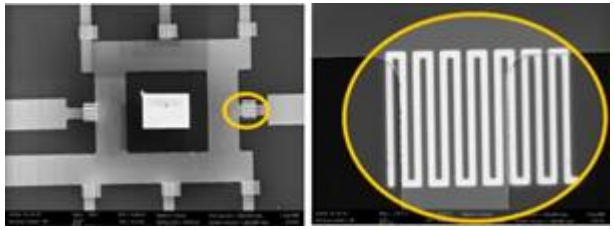


*Photonic cristals in PMMA on silicon for near IR applications*





*Mix-and-match lithography for biomedical applications: optical lithography (left), combined with EBL (right)*

*Mix-and-match lithography for 300 nm fingers used for SAW devices (Cooperation IMT Bucharest- IESL FORTH )*

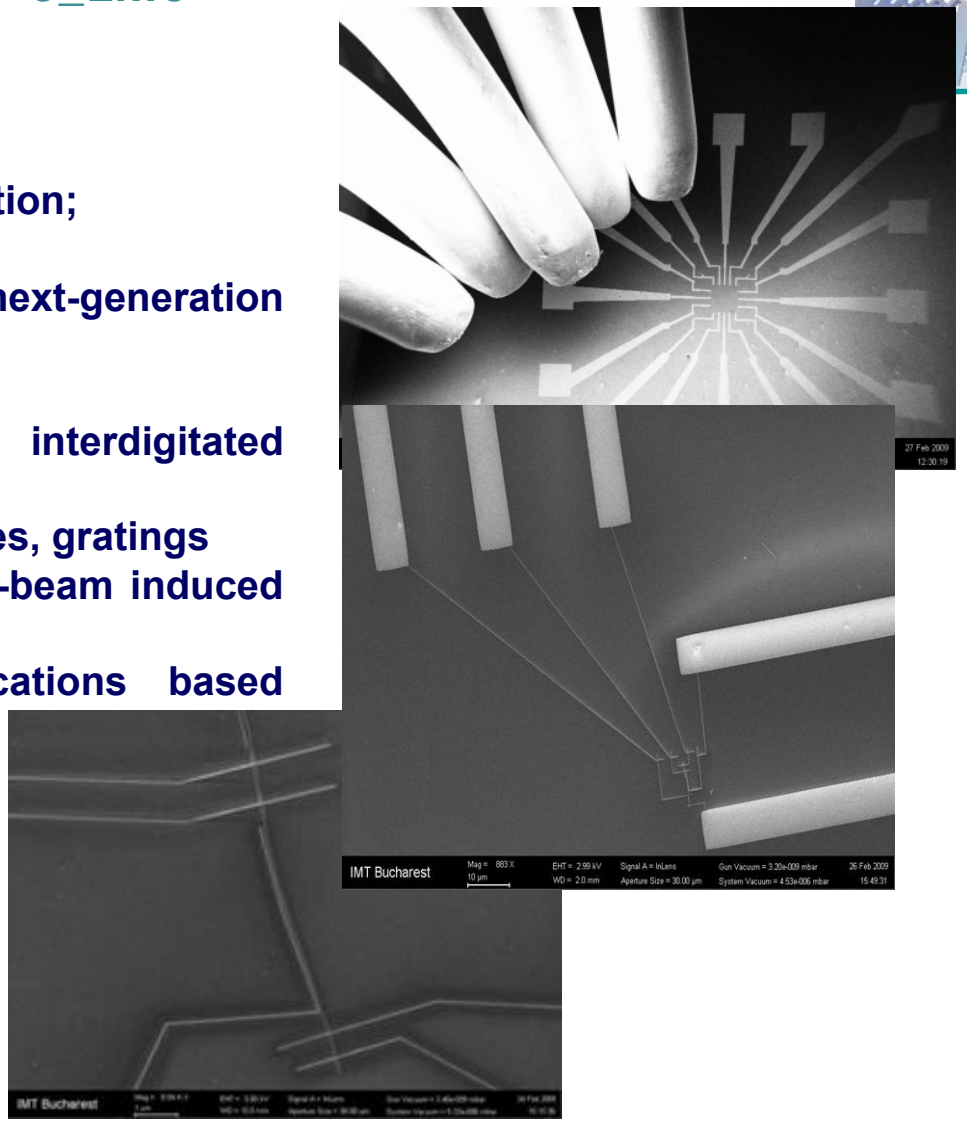
NanoScale Lab

## Research Topics

- Nanolithography with sub 20 nm resolution;
- Three-dimensional nanostructures;
- CNT based interconnections for next-generation integrated circuits
- CNT based nanodevices
- SAW devices with nanometer interdigitated electrodes;
- Optical devices, holograms, micro lenses, gratings
- Development of Nanodevices using E-beam induced deposition and etching
- Development of circuits for communications based on photonic crystals

## Cooperation

- **FP7 CATHERINE Project FET- STREP:** Carbon nAnotube Technology for High-speed nExt-geneRation nano-InterconNEcts
- **INFN- Roma**
- **MIMOMEMS**
- **UCL**
- **Inst. Biodinamica**
- **INCDFLPR**
- **Zoom - Soft SRL**




Structure obtained using conventional lithography and EBID for 4-probe measurements of electrical properties of a polymer nanowire
(Cooperation **IMT Bucharest – UCL**)

NanoScale Lab

# Field Emission Gun Scanning Electron Microscope (FEG-SEM)
## *Nova NanoSEM 630*
## FEI Company, USA

- ultra high resolution in the nanoscale range, for a variety of applications that involve sample characterization, analysis for S/TEM sample preparation

**Research**

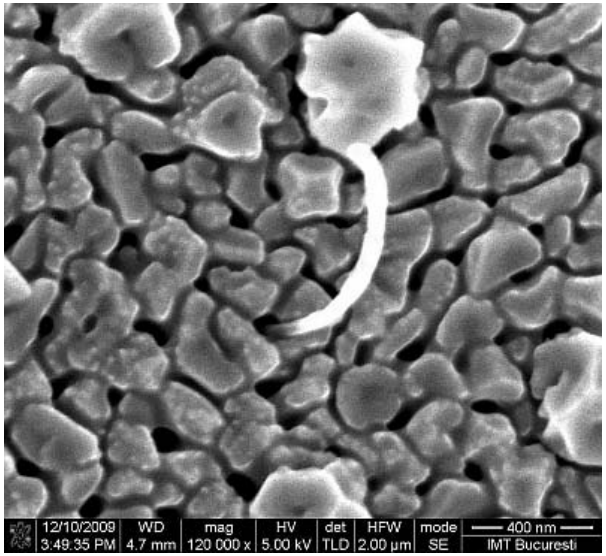
- Materials Qualification
- Surface morphology inspection
- Nanometrology
- Device Characterization

**Main current cooperation**

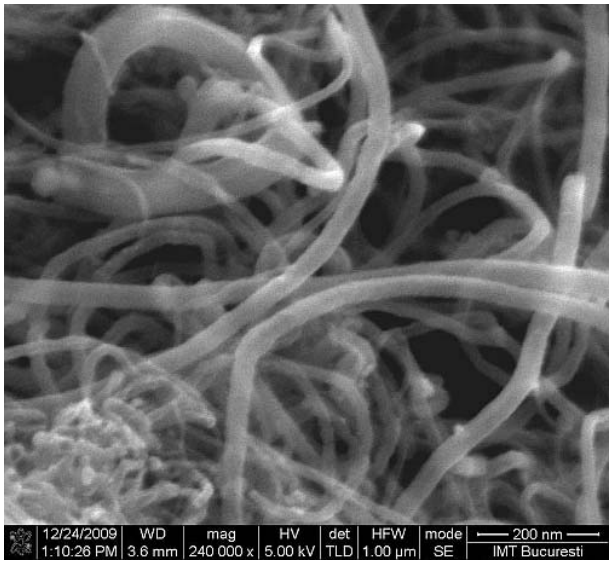
- *INFN Rome*
- *FORTH Heraklion*
- *Univ. Salerno*
- *Univ. Kyoto*

NanoScale Lab

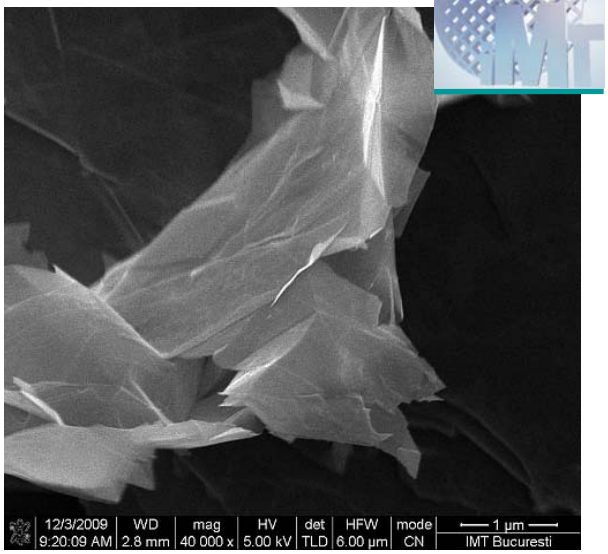
# Nova NanoSEM 630



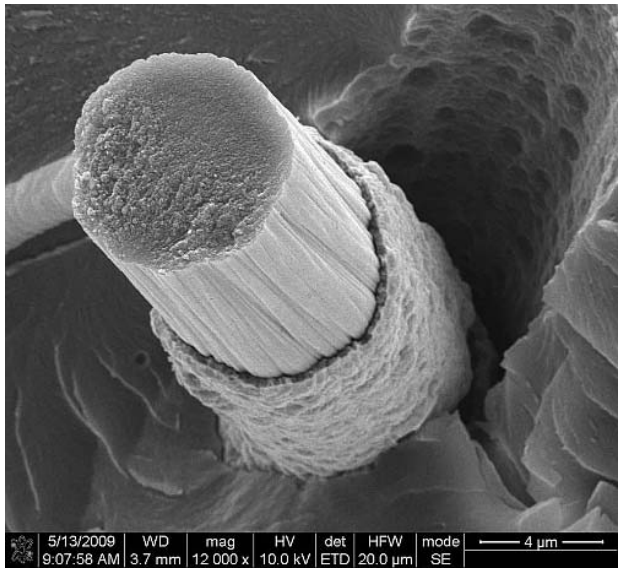

Carbon nanotube grown in porous Al2O3
(IMT Bucharest for **FP7 CATHERINE** )



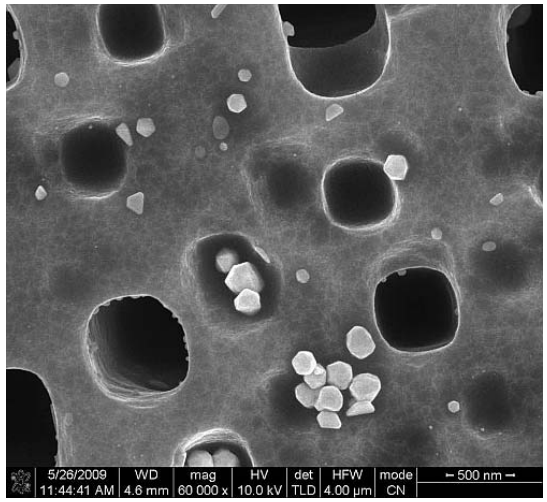

CNT "buckypaper"
(IMT Bucharest for **national project** )



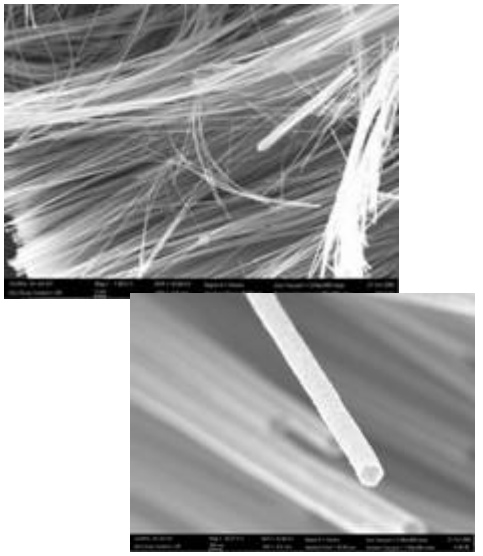

Graphene flakes
(IMT Bucharest, **national project** )




Nanofiber bundle coated with Ni, embedded in polymer susbtrate - applications in aeronatics (radar screening) - sample from INFN Rome




Au nanoparticle clusters on porous Si
(**national project**, biosensing)



HR CNT bundle

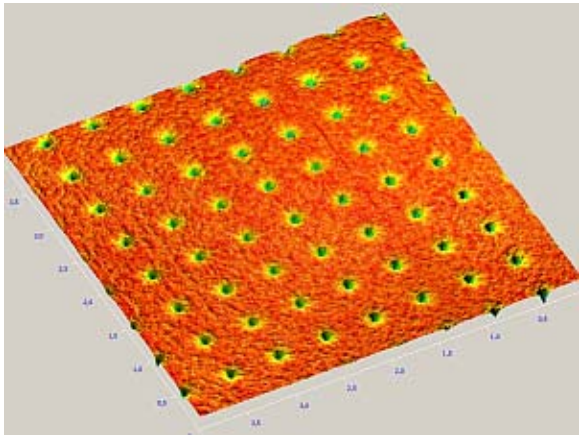
NanoScale Lab

# Scanning Probe Microscope
## *NTEGRA Aura*
## NT-MDT Co., Russia

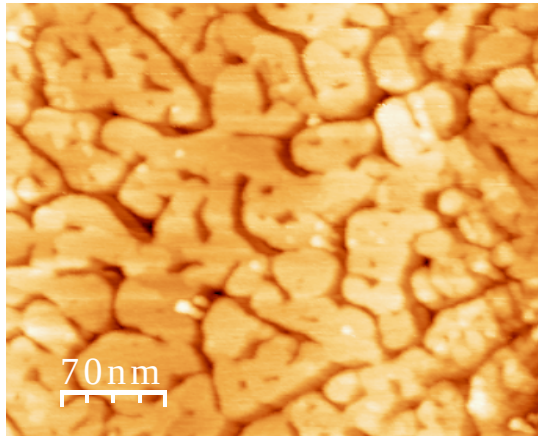
- **AFM - dry**
- **AFM - wet cell**
- **STM**
- **LFM**
- **etc.**

### Research

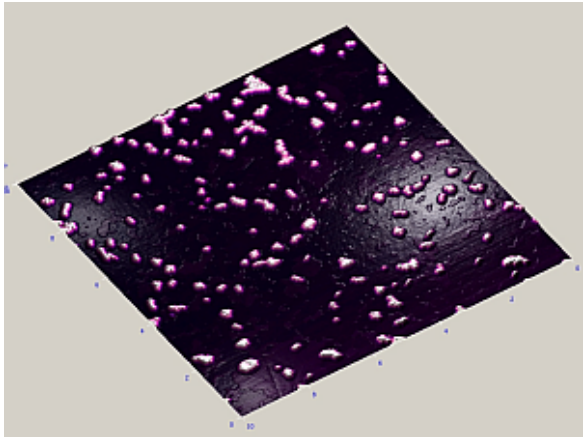
- Surface morphology inspection
- Quantitative measurement of surface features at nanometric level
- Nano-surface texture/ roughness measurement
- High-resolution surface profilometry
- Evaluation and optimization of thin film coatings for various applications (optical, packaging, paintings, wear-resistant etc)
- Grain and particle size analysis
- Surface cleaning and polishing studies
- Morphological studies of biological and biocompatible materials



AFM: EBL 80nm pits




STM: Terrraces of template stripped gold



AFM: Latex nanoparticles on quartz

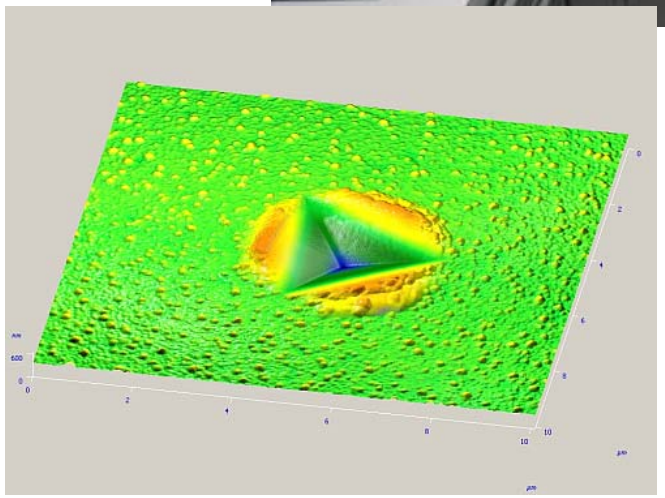
NanoScale Lab

# Nanomechanical Characterization equipment
## *Nano Indenter G200*
## Agilent Technologies, USA

**Research**

•High resolution *mechanical characterization* of a wide variety of materials in small volumes, thin films and coatings:
-metals,
-semiconductors
-ceramics
-biocompatible material.

•Determine:
-hardness,
-film adherence
-wear behaviour, etc.



Al indentation study

MIMOMEMS labs

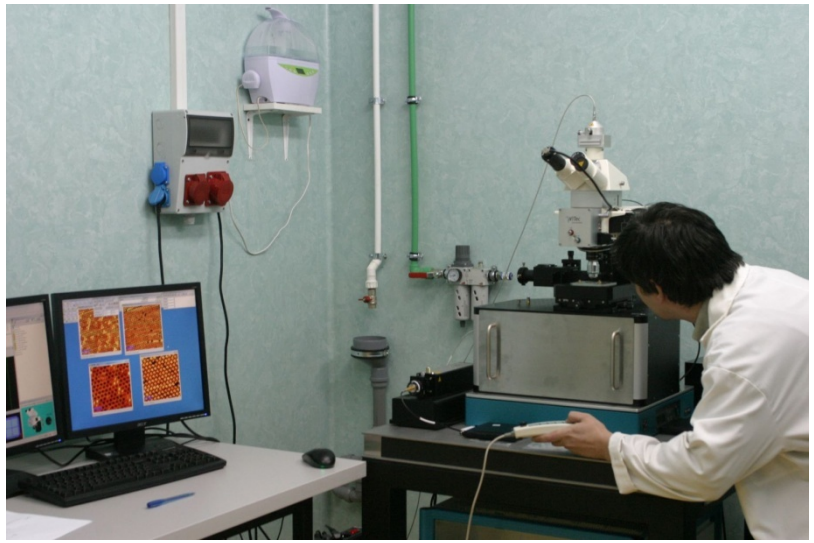
MIMOMEMS

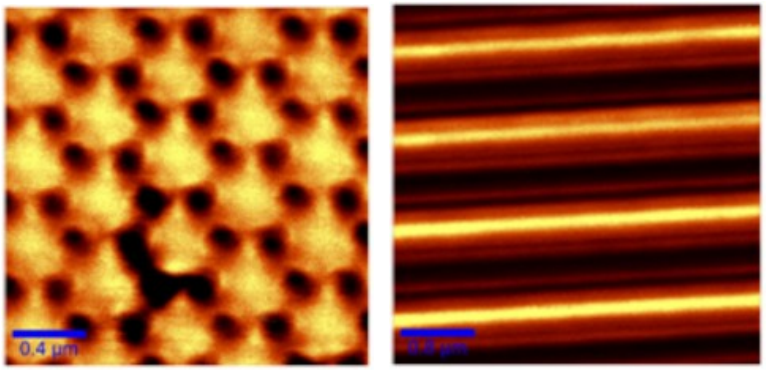
# Equipments acquired in the MIMOMEMS project

- **Vector Network Analyzer (VNA) up to 110 GHz** and **on wafer measurement facilities in order to upgrade the 0.8-65 GHz existing on wafer characterization system**
- **Frequency synthesiser up to 65GHz**
- **Au plating facility for semiconductor wafers**
- **White light interferometer- optical profiling system for research applications**
- **Near field scanning optical microscope (SNOM)**

MIMOMEMS labs

# Scanning Near-field Optical Microscope
## *alpha 300S*
## Witec, Germany






Nanostructure characterization by near field scanning optical microscopy: a) transmission mode image of a hexagonal array of aluminium regions deposited on a glass substrate (Fisher pattern). b) reflection mode image of an array of polymer stripes realized by electron beam lithography.

**Operating Modes:**

***Near-field microscopy*: transmission, reflection, collection, fluorescence**

***Confocal microscopy*: transmission, reflection, fluorescence, can be upgraded with a Raman spectrometer**

***Atomic Force Microscopy* contact and AC-Mode**

## Applications:

- Imaging the optical properties of a sample with resolution *below the diffraction limit* with applications in nanotechnology, nanophotonics, nanooptics and plasmonics
- Life sciences
- Materials research
- Single molecule detection.

## Cooperation examples:

- MIMOMEMS-REGPOT-FP7
- FLEXPAET-IP- FP7/NMP

XRD lab

# X-ray Diffraction System (triple axis rotating anode)
## *SmartLab*
## Rigaku Corporation, Japan

**Technical characteristics:**

- 9kW rotating anode, 200mm wafer
- Triple axis, vertical goniometer
- Independent Theta - Theta rotation
- Horizontal sample position; X-Y Micro Area Mapping


***X- Ray methods and applications for structural Analysis:***

**X-ray Powder diffraction (XRPD)**

**High resolution X-ray diffraction (HRXRD)** - phase analysis, crystal orientation, thermal stability

**X-ray reflectometry (XRR, including HRMR XRR )** - layer thickness, density, roughness, interface layers;

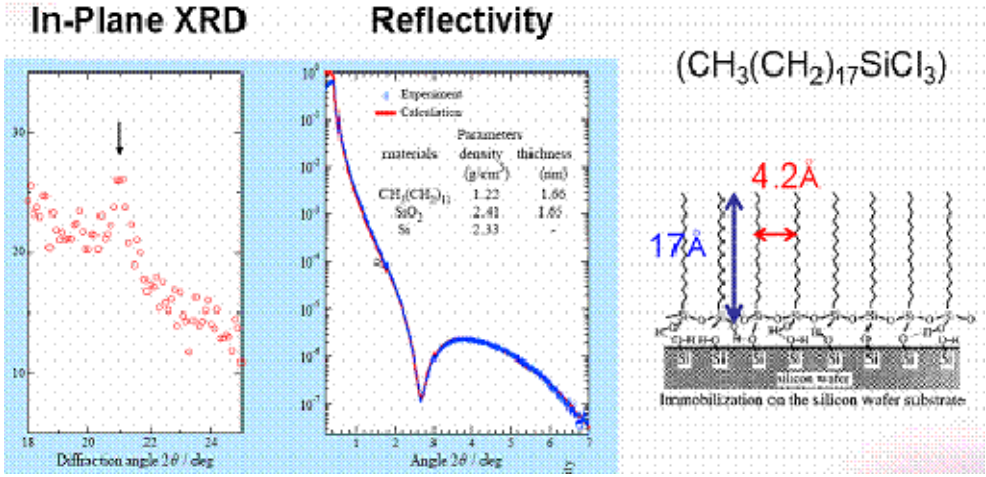
**Grazing incidence diffraction (GIXRD) -** texture analysis and pole figures

**In-plane grazing incidence diffraction (IPGID)**

**Small angle X-ray scattering (SAXS)**

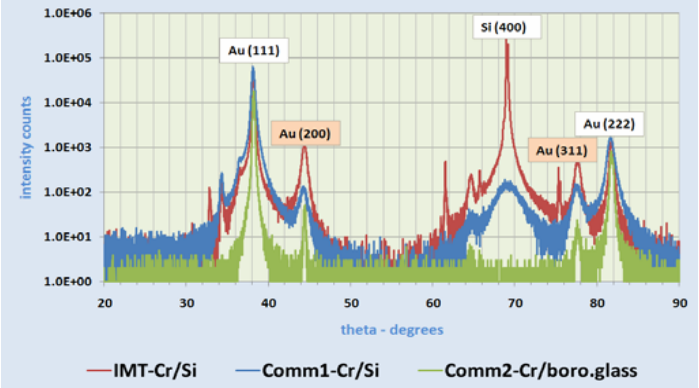
**Single crystal diffraction (SCD)**

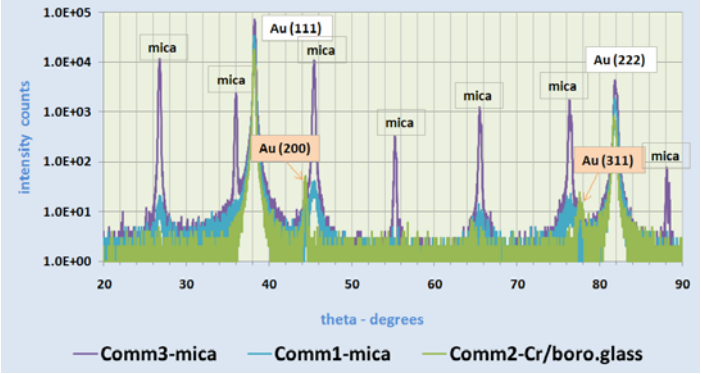
Investigation of the $CH_3(CH_2)_{17}SiCl_3$ organic film monolayer

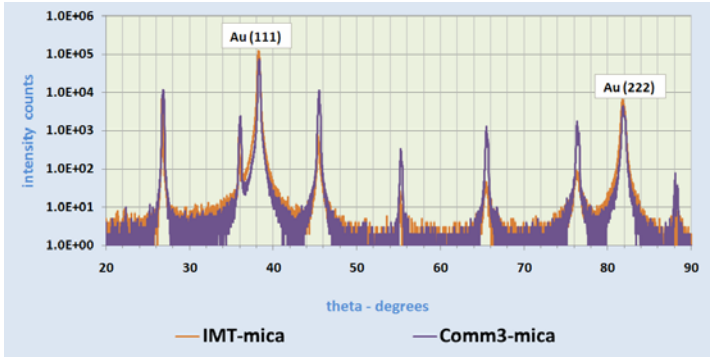


XRD lab

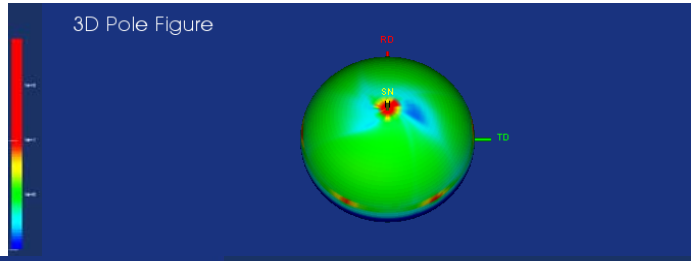
# SmartLab

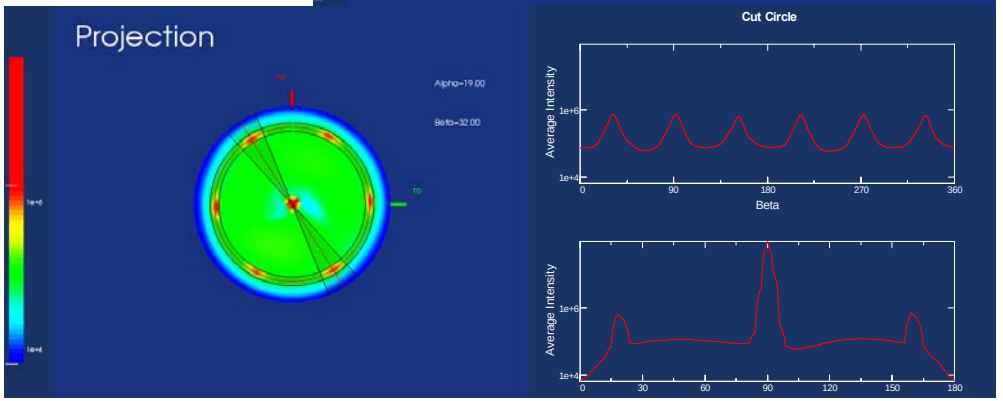



Investigation of IMT-optimized Au 111 deposition



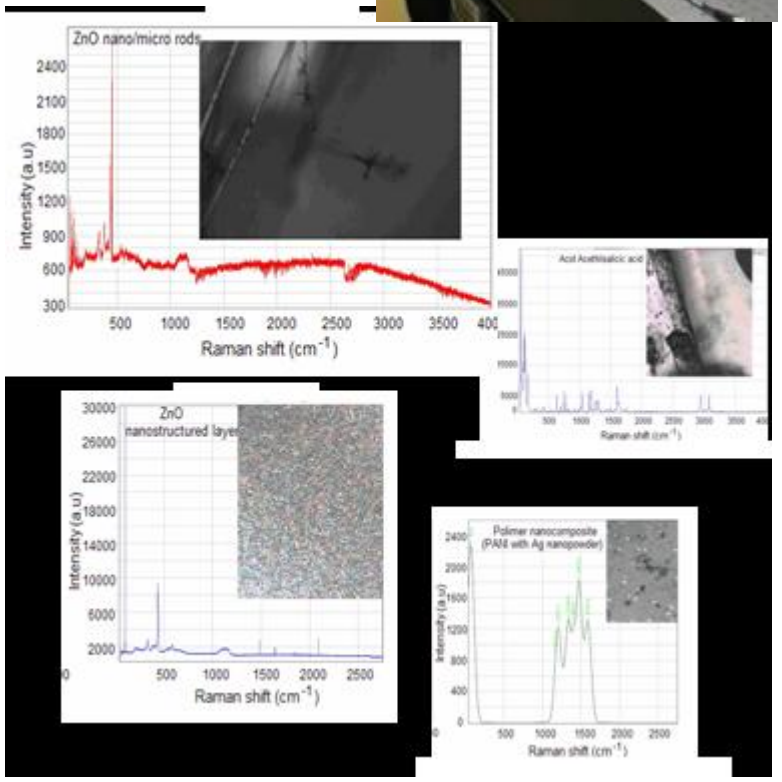



RAMAN lab

# High Resolution Raman Spectrometer
## *LabRAM HR 800*
## HORIBA Jobin Yvon, Japan

## μ- Raman investigations of micro/nano structures

- composition and phase (crystalline/amorphous) of composites materials;
- nature of oxides on compound semiconductors;
- polymers characterizations and polimer nanocomposites;
- chemical and biological detection using SERS technique;
- micro/nano structures characterization - micro/nanorods, carbon nanotubes (CNT), self
- self assembled molecule (SAM) on functionalized substrate for nano- bio applications



# Nanobiotechnology laboratory: NanoBioLab

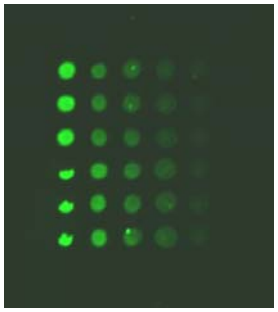
NanoBioLab

## Micro-Nano Plotter
## *OmniGrid*
## Genomic Solutions Ltd., UK

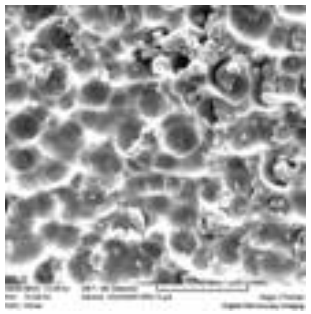
Dip and spot a given volume of sample solution onto a solid surface

**Print speed:**
10,000 spots/11 slides in less than 3.5 hr

Vacuum wash station for washing between sample transfers; humidity control minimizes sample evaporation



Microarray sample



Au/PS samples after BSA printing - SEM

Cooperation example:

- DNASIP-ERA-NET- focused diagnostic DNA chips

NanoBioLab

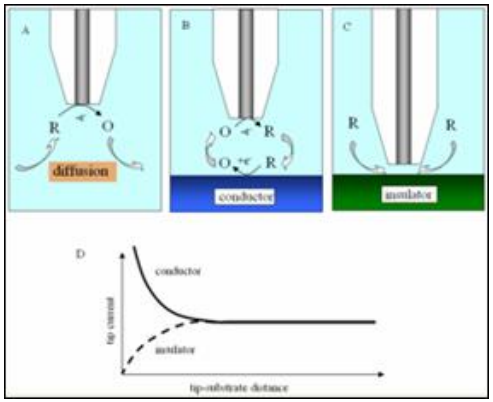
# Scanning Electrochemical Microscope
## *ElProScan*
## HEKA, Germany

• Positioning system with 3 stepper motors (XY - 100 nm or 15 nm stepper motors) and a piezo translator (5 nm resolution and 100 mm scan range, closed loop regulated) mounted on a granite portal including fundamental plate

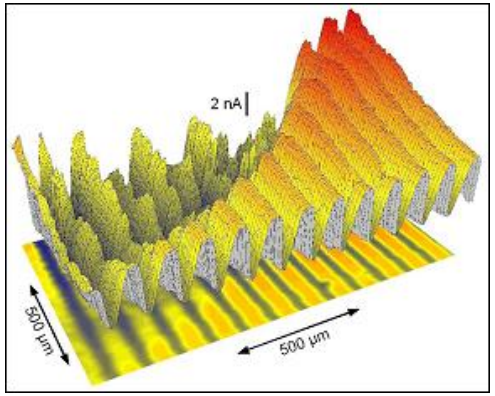
• Bipotentiostat/Galvanostat PG 340 with two low current Preamplifiers

• Software POTPULSE with SCAN extension

**Principle of detection**




**Directly measuring of the catalytic activity of biosensor microelectrode arrays**

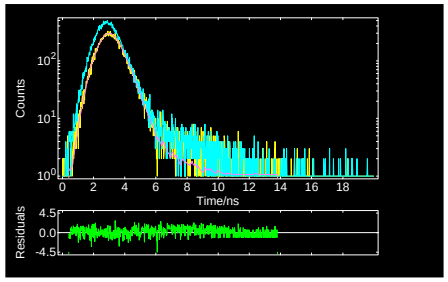



**Applications:**

- *Constant - distance Nano-SECM → Substrate imaging (Topography);*
- *Temperature-Controlled SECM;*
- *SECM for local corrosion investigation;*
- *Chemical reactivity → Heterogeneous electron transfer reactions studies; Electrocatalysis*
- *Probing patterned biological systems*
- *Bio SECM - Membrane transport*

NanoBioLab

## Combined Time Resolved and Steady State Fluorescence Spectrometer - *FLS920P* - Edinburgh Instruments, UK




Fluorescence decay of BSA-Cy3

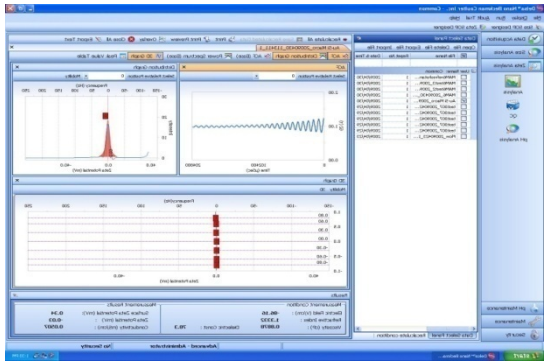
**Applications: photophysics, photochemistry, biophysics and semiconductor.**

**Biomedical field:** study of enzymes, dynamics and structure of nucleic acids, protein folding and DNA sequencing.

**Pharmaceutical :** monitoring drug interactions**.**

**Materials physics:** study nanostructures such as quantum wells and quantum dots; characterisation of doping or impurity level in semiconductors.

## Zeta Potential and Submicron Particle Size Analyzer - *DelsaNano* - Beckman Coulter, USA



### Applications

- **Formulation / tableting**
- **Final QC**
- **Formulation stability**
- **Research**
  - **Virus, bacteria**
  - **protein applications (aggregation)**
  - **bio-nanoparticles**
  - **Lyposomes, lipids, polysaccharides**
  - **Colloid drug carrier systems**
  - **Parenteral and oral drugs**
  - **micelles**
- **Zeta potential of tablet surface**

Reliability lab

## Testing for reliability

- **Semiconductor Characterization System (DC) with Wafer Probing Station - *4200SCS/C/-***
  ***- various modules-*** (Keithley Instruments, USA)
- **Mobile Thermal Airstream System - *ThermoStream TP04300A-8C3-11*** (Temptronic, USA)
- **Damp heat Climatic chamber** (Angelantoni, Italy)
- **Electrodynamic vibration system with thermal and electrical tests - *TV 55240/LS*** (TIRA, Germany)
- **Thermal shock chamber - *TSE-11-A*** (Espec Europe, Germany)
- **Universal Ovens with electrical testing - *UFB 400*** (Memmert, Germany)
- **Highly Accelerated Stress Test Chamber - temperature, humidity, pressure, polarization - *EHS-211M*** (Espec Europe, Germany)
- **Free Fall Shock Machine - *0707-20*** (MRAD, USA)


CAD/CAE/Multiphysics

## Simulation, Modeling, CAD / CAE, Multiphyiscs

**Coupled analysis for MEMS**

**CoventorWare 2008.010 (COVENTOR, USA)**

ARCHITECT, DESIGNER, ANALYZER, MemElectro, MemMech, CoSolveEM, MemETherm, MemPZR, MemPZE, Damping MM, InertiaMM, MemHenry, MemCFD, Netflow, SwitchSim, ReactSim, MemFSI, BubbleSim, DropSim, SEMulator3D, EM3D

**Ansys Multiphysics 11.0 (ANSYS, USA) - structural, thermal, acoustic, electromagnetic and coupled field analyses, CFD**

**COMSOL Multiphysics**

**Photonic components - simulation, modeling and design**

**Opti FDTD 8.1, Opti-HS, OptiBPM 9.0, OptiGrating (Optiwave, Canada)**

**Microwave and millimeter wave circuits and microsystems: design and modeling**

**IE3D, FIDELITY (Zeland, USA)**

**Quantum physics/chemistry : electronic structure calculations and *ab initio* molecular dynamics simulations of molecules and solids**

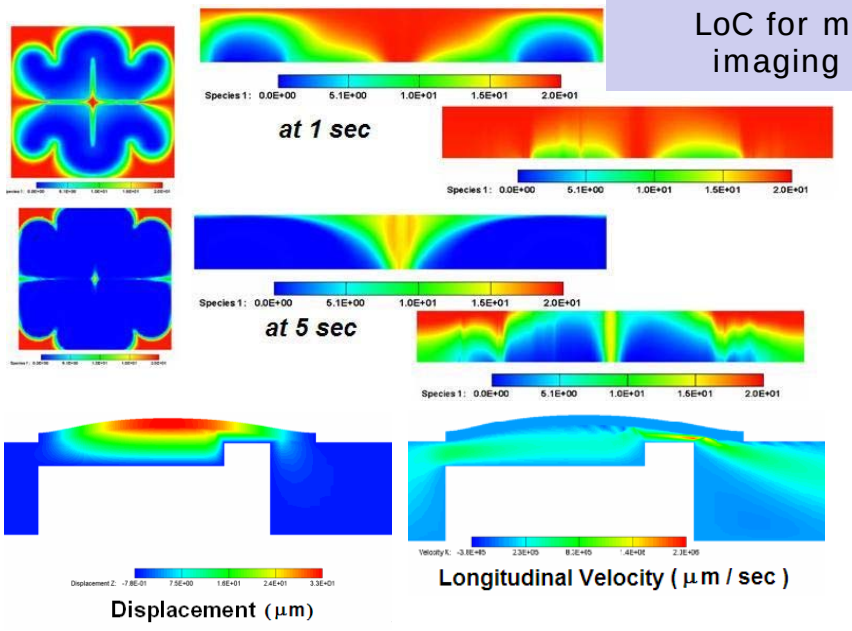
**SIESTA (ICMAB-SIESTA)**

**Other tools**

**TransMagic STANDARD (TWeatherford, USA)**
**SolidWorks Office Professional (SolidWorks, USA)- 3D CAD design software**
**Mathematica 7 (Wolfram, USA)**
**Matlab 7 (The MathWorks, USA)**
**OriginPro 8 (OriginLab, USA)**
**Visual Studio 2008 Pro Programming tool for RAD and IDE.**

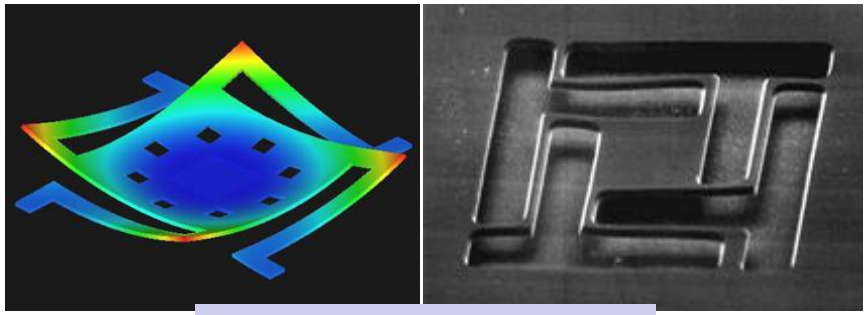
CAD/CAE/Multiphysics

LoC for molecular imaging agents

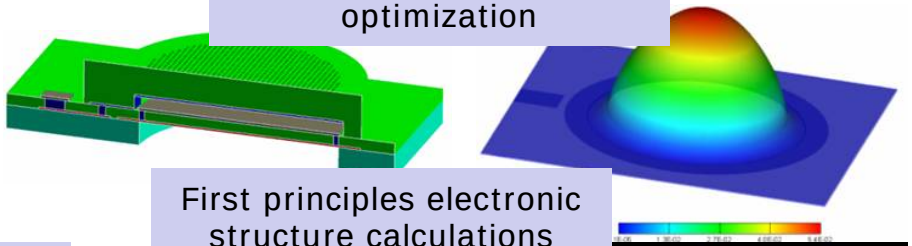



**MI-Lab-on-Chip - FP6 STREP/NMP**

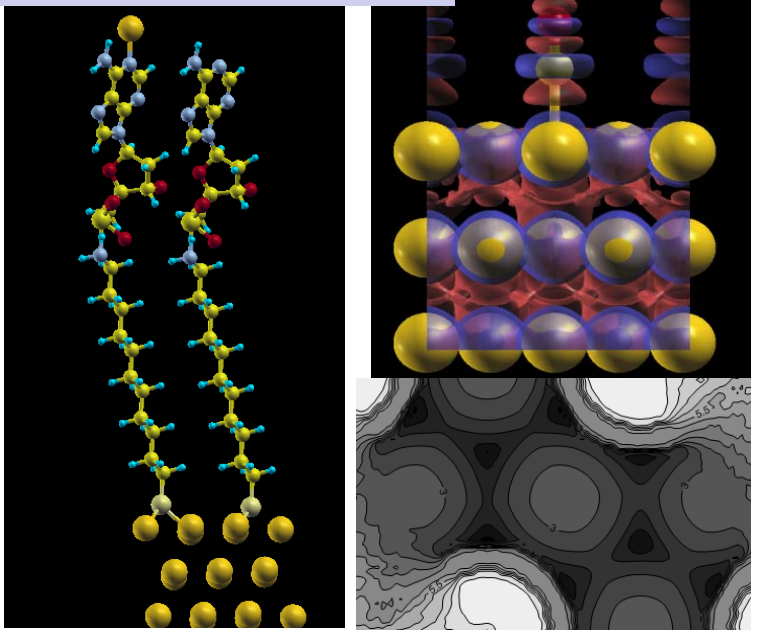
Si microreflector optimization



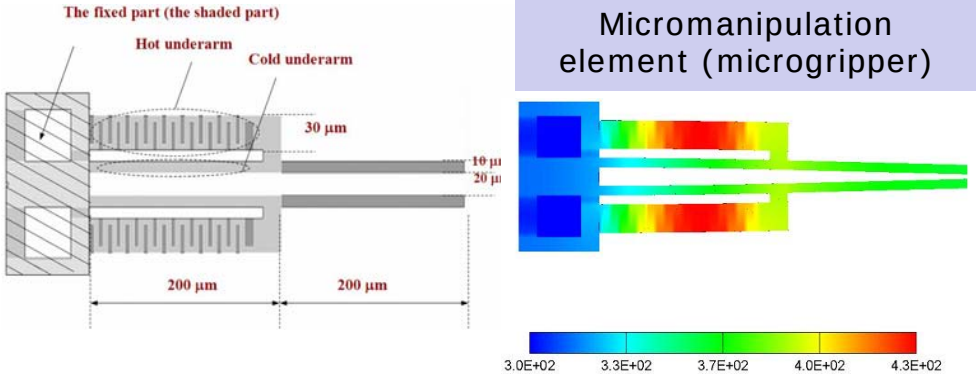
Capacitive microphone optimization



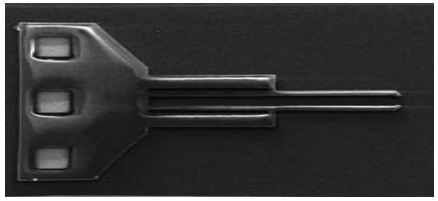
First principles electronic structure calculations



Micromanipulation element (microgripper)




**MEMSAS - CEEX**



# Perspectives

- At the level of IMT
  - Continuing the policy of attracting cooperation with industry:
    - Providing room in the technological area for equipments of companies
    - Developing joint services with companies working in the field
    - Attracting the interest of important companies with subsidiaries in Romania
  - Consolidating the connection with universities:
    - Four M.Sc. courses fully sustained by IMT
    - Increasing the number of Ph.D. students working out their thesis in IMT - a POS-DRU project will finance up to 35 post-doc students
- At National level:
  - Network of experimental facilities and of centers with complementary facilities in nanotechnology
  - Financial support from public funding
    - Direct, subsidies for a facility of national interest
    - Indirect, a support programme facilitating the access of SMEs to technological facilities
- European, international level:
  - Memberships in European networks of facilities
  - Extending the customer basis - a policy of collecting and disseminating information on various occasions; extending the area of interest.

# Complete information

- **IMT-MINAFAB full info -**
  **www.imt.ro/MINAFAB/**

- **Current projects and achievements: IMT-Bucharest - SCIENTIFIC REPORT 2008 -**
  **www.imt.ro/raport_anual_2008.pdf** (soon available for 2009)

- **IMT-Bucharest - Brochure for scientific-technological services -**
  **www.imt.ro/brosura_imt_bucuresti_2009.pdf**

- **Quick list of capabilities and tools -**
  **http://www.imt.ro/MINAFAB/description.htm**

**Thank you for your attention!**