



Institutul National de Cercetare - Dezvoltare pentru Microtehnologie (IMT- Bucuresti)

Departamentul de cercetare stiintifica si tehnologica - Dir. Dr. Raluca Muller

L1 - Laboratorul de Nanotehnologie, Dr. Irina Kleps

L3 - Laboratorul de Microfotonica, Dr. Dana Cristea

L4 - Laboratorul de Microstructuri, Dispozitive si Circuite de Microunde,
Dr. Alexandru Muller

-Centrul de servicii stiintifice -Dir. Dr. Radu Popa

L5 - Laboratorul de Modelare, Simulare si Proiectare asistata de calculator,
Dr. Raluca Muller

L6 - Laboratorul de Microcaracterizare fizica si Nanostructurare, Fiz. Adrian Dinescu

L7 - Laboratorul de Fiabilitate, Dr. Marius Bazu

- Centrul de cercetare pentru integrarea tehnologiilor – Dir. Dr. Mircea Dragoman

L2 - Laboratorul de Microsisteme pentru Aplicatii Biomedicale si de Mediu,
Dr. Carmen Moldovan

L8 - Laboratorul de Tehnologii Ambientale, Dr. Ileana Cernica

L9 - Laboratorul de Nanotehnologie Moleculara, Dr. Radu Popa



LABORATORUL DE NANOTEHNOLOGIE – L1

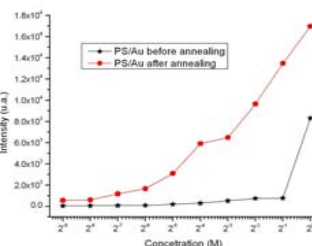
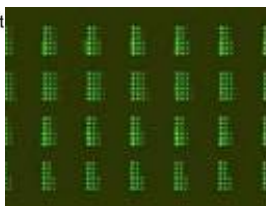
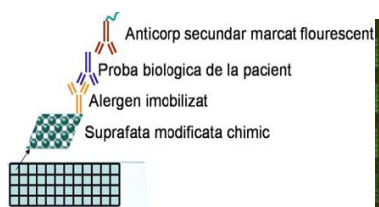
Sef de laborator: Dr. Irina KLEPS
irina.kleps@imt.ro



L1: Tehnologia microarray-urilor

Expertiza

Fabricarea microarray-urilor, modificari chimice de suprafata, analiza sistemelor de tip microarray.



Dotarii existente

"GeneMachines OmniGrid Micro" - Nano-Plotter,
"GeneTAC UC4 Microarray Scanner"



Aplicatii

genomica, pharmaco-genomica, genotipare, proteomica,
analize medico legale, diagnosticare bazata pe chip tip
microarray

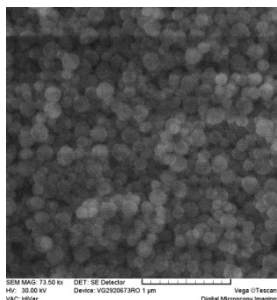
Oferta de servicii

*Realizare structuri tip microarray pentru
diagnosticare in domeniul medical*

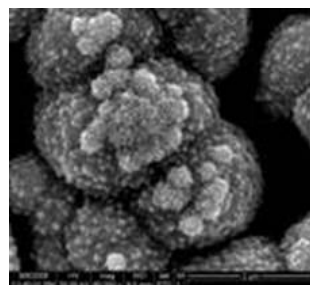
- depunere controlata de material biologic
- fabricarea microarray-urilor ADN, proteine in conditii stabilite cu utilizatorul
- obtinere de suprafete suport nanostructurate pentru chip tip microarray
- modificari chimice de suprafata pentru imobilizarea probelor biologice- DNA, proteine, celule,
- analiza sistemelor de tip microarray marcate florescent prin scanare laser
- analiza sistemelor microarray prin spectroscopie de florescenta



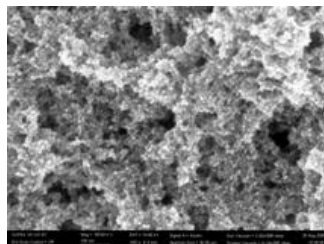
L1: Preparare si caracterizare nanoparticule - oferta de servicii -



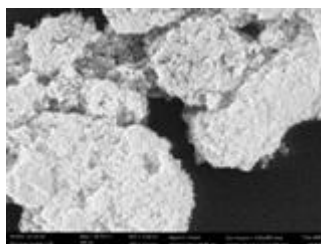
Nanoparticule de SiO₂



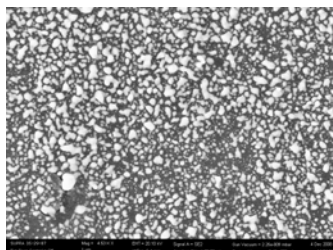
Nanoparticule de Pt



Nanoparticule de Au



Nanoparticule de Fe



Nanoparticule de Ag

Aplicatii

- Preparare de dispersii coloidale de nanoparticule: *Au, Pt, Ag, Fe, Fe₂O₃/Fe₃O₄; SiO₂, TiO₂, SnO₂* sau de sisteme *core-shell, functionalizate sau ne-functionalizate*
- *Fenomene de capilaritate care sunt importante in udarea pulberilor*
- *Acoperiri de suprafete*
- *Adsorptii de impuritati*
- *Domeniul biomedical/ farmaceutic: determinari de proteine, lipide, polizaharide, bacterii, virusuri, sisteme coloidale purtatoare de medicamente, medicamente in suspensii apoase, micle*

Echipament Delsa™ Nano C- Zeta Potential & Particle Size Analyzer





Laborator experimental de caracterizari electrochimice pentru studiul interfetelor

Profilul laboratorului:

caracterizari electrochimice pentru probe biologice;
caracterizari electrice/electrochimice pentru dispozitive electronice;

1. Spectrometru de impedanta

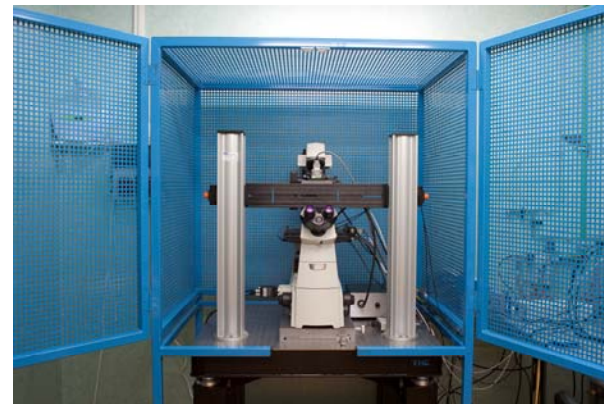
- *Caracteristici tehnice:* masuratori de impedanta; AMETEK-rezolutie $< 1\mu\text{V}$ pentru electrodul de referinta, maxim de current /tensiune aplicabila $\pm 2\text{A} / \pm 14.5\text{ V}$, rezolutie $1\text{pA}/1\mu\text{V}$;
- *Utilizare:* masuratorile EIS dau informatii despre parametrii de reactie ratele de corodare, calitatea oxidului, porozitatea suprafetelor, transportul de masa si alte caracteristici ale interfetei electrod / electrolit.

2. Combina electrochimica Tehnici disponibile: CV si SWV;

- *Caracteristici tehnice:* Intensitate: 0-12A, 0-24A; Tensiune: 0-36V; Tensiune programabila: 10mV; Intensitate programabila: 3mA for 12A and 6mA for 24A;
- *Utilizare:* Identificari de specii electrochimice; Functionalizari specifice si; depuneri/corodari electrochimice

3. Microscop cu scanare electrochimica (SECM)

- *Caracteristici tehnice:* Precizie axe z: 100nm+piezo 5nm; x,Y 100(EIProScan); XY15nm (EIProScan HR), Arie:50nm, rezolutie $< 1\text{nm}$, timp de raspuns 4ms, masa antivibratie, dimensiuni 450x450x60mm;





Applications

Imaging and positioning

Studies of heterogeneous electron transfer reactions

Studies of homogeneous chemical reactions

Characterization of thin films and membranes

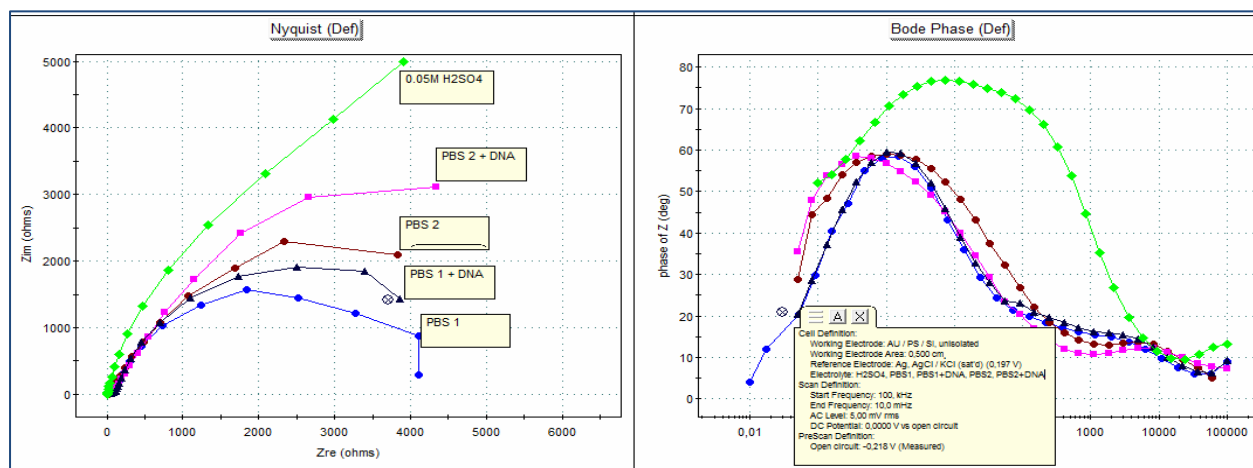
Membrane transport

Liquid-liquid interfaces

Probing patterned biological systems

Fabrication: deposition or etching.

- Contact Person: Dr. Mihaela Miu



Porous silicon as sensing layer for DNA binding



Difractometru de inalta rezolutie (axa tripla) Rigaku Smartlab R&D 100, 2006 (USA)

Proiect Capacitati ,PNII 2007-2009, nr.55/CP/I/14.09.2007, LADRIX

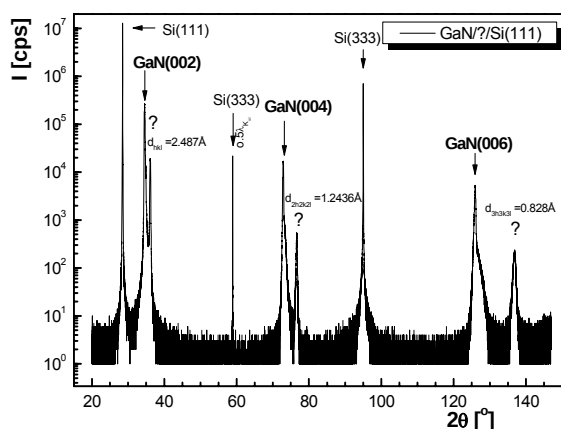
Persoana contact: Mihai Danila

Laborator L1, www.imt.ro/ladrix/, tel: 021-4908085

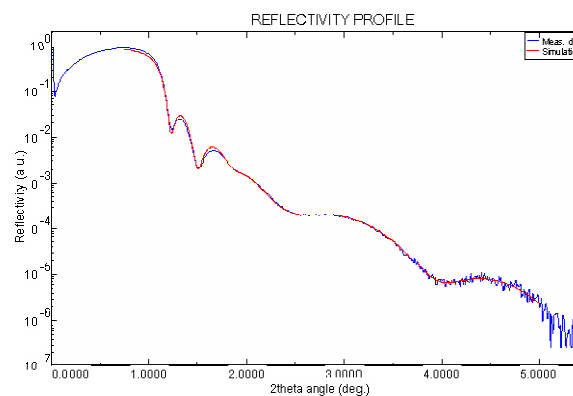


Applications:

- crystal structure (HR RSM, HR RC);
- film thickness, density, roughness;
- characterization of the ultra thin film (in plane XRD);
- particle/ pore size analysis (reflection SAXS, transmission SAXS)
- phase identification, crystal structure (powder/thin film/poly/mono/ crystall, trace, small area/quantity);



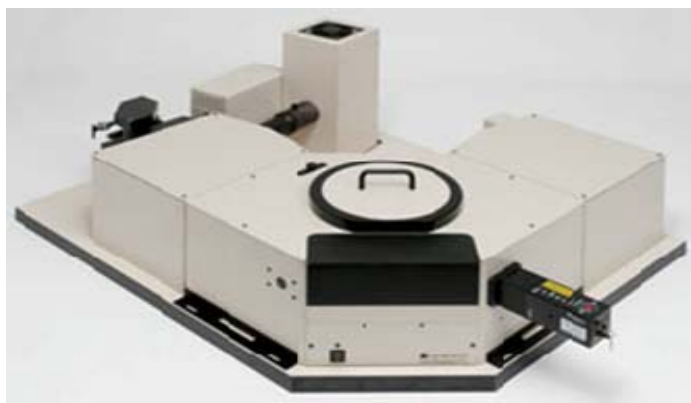
WAXRD and rocking curve measurement of GaN {001} sample on Si(111)



Reflectivity and structure measurements of ultrathin Au/Cr/Glass (transparent)



Fluorescence lifetime and steady-state spectrometer Manufacturer: Edinburgh Instruments, Model: FLSP 920



Fluorescence lifetime and steady-state spectrometer (FLSP 920) is a suite of combined steady state and time resolved luminescence (fluorescence and phosphorescence spectrometers fabricated by Edinburgh Instruments.

Applications in the broad areas of photophysics, photochemistry, biophysics and semiconductor study. Complex intermolecular interactions can be revealed by lifetime measurements made across an emission spectrum which has little structure.

Biomedical field: study of enzymes, dynamics and structure of nucleic acids, protein folding and DNA sequencing, use a-priori fluorescence lifetime knowledge of the fluorescent probe to characterise various systems.

Materials physics: study semiconductors and novel structures such as quantum wells and quantum dots or for the quality control monitoring in a wafer foundry, to characterise the doping or impurity level present.

Pharmaceutical sector: for monitoring drug interactions by studying the energy transfer mechanisms using fluorescence lifetimes as the indicator.

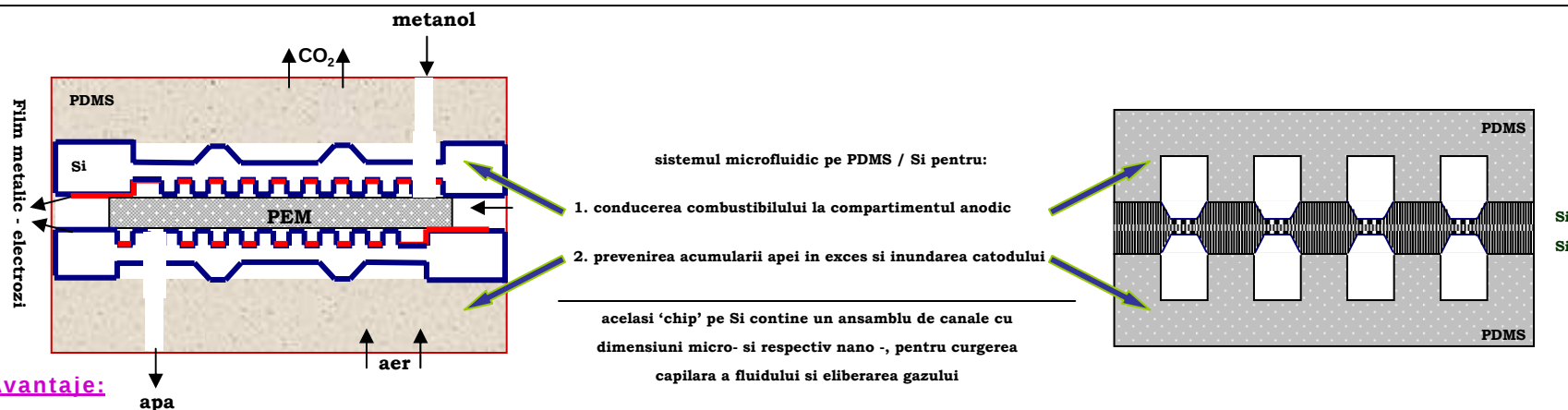


L1: Tehnologie de fabricare a celulei de combustie miniaturizate ca sursa de putere pentru electronica portabila -1-

Utilizind procese din tehnologia de fabricatie MEMS s-a *pus la punct tehnologia* si s-a *obtinut un dispozitiv complex care sa functioneze autonom* – in curs de testare la parteneri.

Este realizata o arhitectura 3D prin asamblarea a 2 componente:

- C1. ansamblu membrana /electro-catalizator (MEA) de tipul nanoparticule catalizator pe suport de siliciu nanostructurat sau nanotuburi de carbon, unde au loc reactiile de productie a energiei;
- C2. microsistem auxiliar de circulare (alimentare/inmagazinare) a combustibilului/apei pe siliciu si PDMS.



Avantaje:

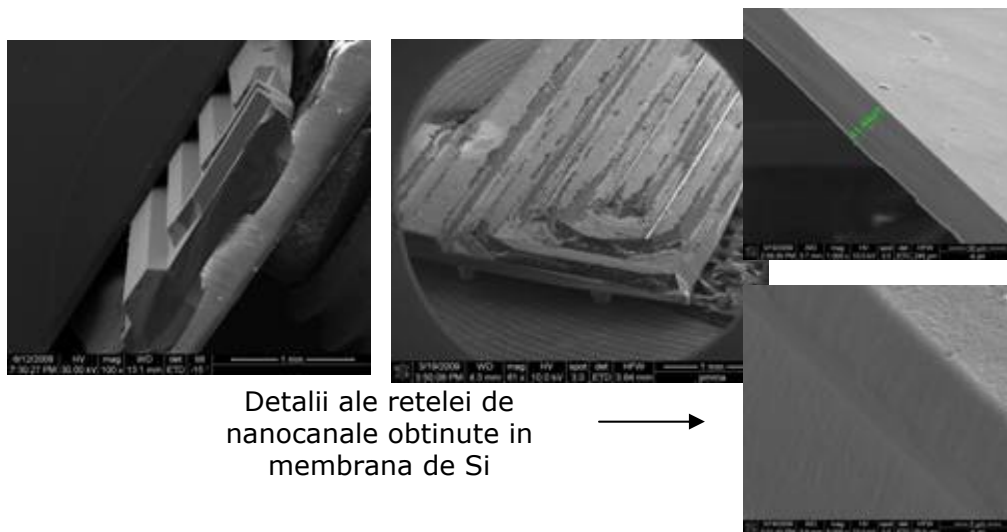
- alimentarea directa cu combustibil lichid (metanol/etanol), fata de celulele de combustie cu H₂ comerciale scade costul de intretinere si functionare, simplifica modalitatea de stocarea combustibilului si creste eficienta de conversie; in plus, etanolul poate fi obtinut din surse alternative petrolului, ca de exemplu din prelucrarea de masă vegetala (*factory farming*) sau deseuri (*green-chemistry*) si este regenerabil.
- tehnologie simpla, intregul dispozitiv se realizeaza prin procese electrochimice de corodare anodica;
- membrana nanostructurata din siliciu poros (**pori 5-10 nm**): avantaj raport mare suprafata/volum care conduce la accelerarea reactiilor electrochimice;
- catalizator din Platina (microparticule nanostructurate)



L1: Tehnologie de fabricare a celulei de combustie miniaturizate ca sursa de putere pentru electronica portabila -2-

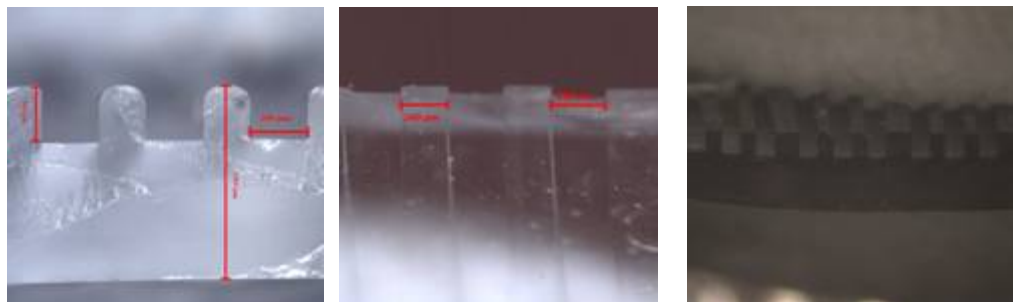
1. Sistemul microfluidic

Imagini SEM ale structurii microfluidice in Si

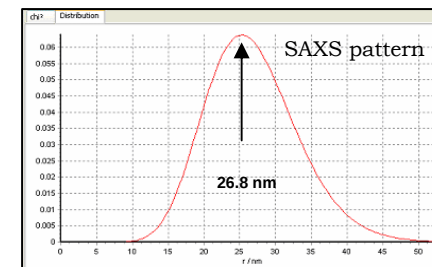
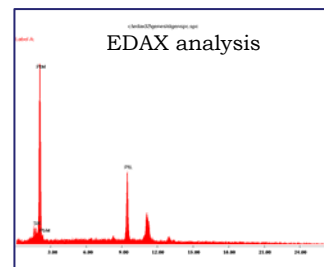
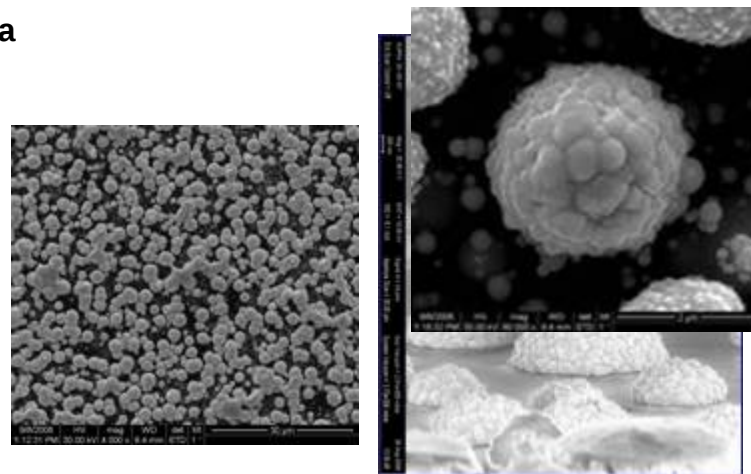


Detalii ale rețelei de nanocanale obtinute in membrana de Si

Imagini optice ale structurii microfluidice in PDMS



2. Membrana electrocatalitica, PS + nanoparticule de platina



OBSERVATII:

→ prin reducerea dimensiunilor, se utilizeaza o cantitate minima de catalizator, obtinandu-se in acelasi timp o crestere a raportului suprafata activa/volum si implicit o arie activa electrochimic cit mai mare care conduce la accelerarea reactiilor electrochimice.



L1: Platforma microfluidica integrata pentru caracterizarea morfo-structurala a afectiunilor neoplazice cutanate

OBIECTIVE:

- Realizarea unui sistem microfluidic compus dintr-o retea de microcanale, micromixer, microsplitter si micropompa pentru transportul unor cantitati mici de fluid
- Realizarea unei matrice de valve de spin pentru atasarea moleculelor in vederea studiului si eliberarea lor dupa examinare
- Functionalizarea suprafetelor pentru imobilizarea biomoleculelor de interes
- Realizarea unui sistemului optoelectronic pentru sortarea moleculelor si caracterizarea optica a morfologiei biomoleculelor

APLICATII:

- ❖ Diagnosticarea precoce a tumorilor cutanete maligne si benigne (melanoame)
- ❖ Dezvoltarea de noi terapii ale afectiunilor neoplazice (carcinoame bazocelulare, carcinoame spinocelulare si melanoame maligne), patologii in care apar modificari de curgere a fluidelor biologice.

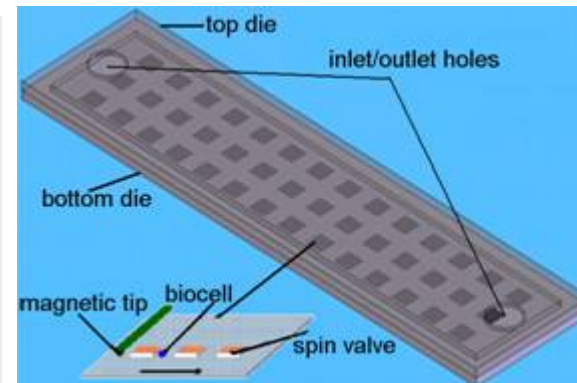
Categorii de utilizatori:

Clinici de oncologie; Specialisti in domeniul microchirurgiei; Producatori de aparatura medicala



Fig.1. Platforma microfluidica (micromixer si microsplitter)

Fig.2. Platforma cu valve de spin pentru sortarea, imobilizarea si rotirea biomoleculelor de interes





L1: Sistem micro-electro-mecanic pentru determinarea semnăturii unui fascicol nervos

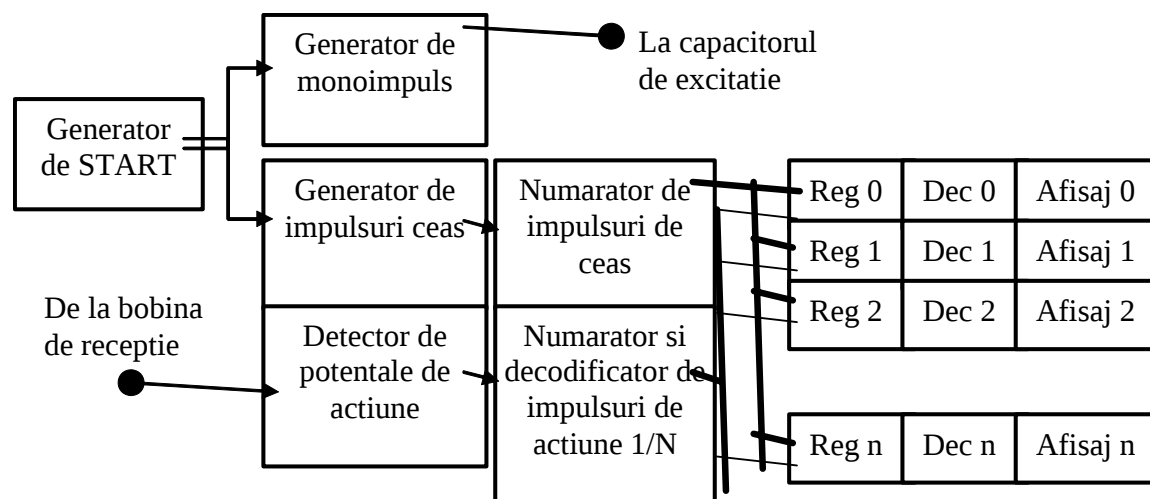
OBIECTIVE:

➤ Realizarea unui Sistem microelectromecanic MEMS alcatuit dintr-o retea de microcanale pentru captarea fasciculelor nervoase, combinata cu un sistem microelectronic de excitatie, receptie si prelucrare a semnalului destinat afisarii unui vector caracteristic fascicolului nervos investigat.

APLICATII:

- ❖ Identificarea pozitionarii fasciculelor nervoase in micro-chirurgia reconstructiva a nervilor periferici
- ❖ Investigarea maladiilor care apar la nivelul nervilor periferici
- ❖ Imperecherea fibrelor nervoase ale unui nerv periferic sectionat

Categorii de utilizatori: Spitale si clinici in care se practica microchirurgia plastica si reparatorie si microchirurgie reconstructiva a nervilor periferici; Producatori de aparatura medicala

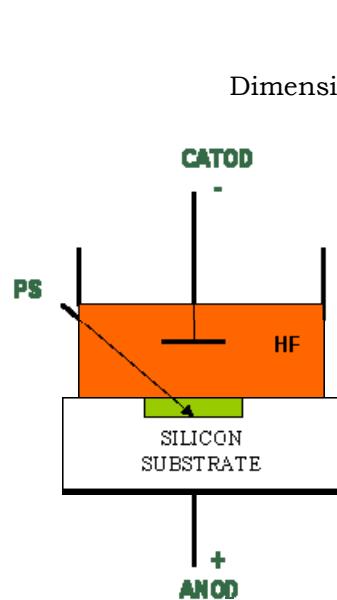


Schema bloc a sistemului microelectronic de detectie si afisare a semnăturii nervoase



L1: SILICIU MICRO- SI NANO- STRUCTURAT –PREPARARE si APLICATII

OFERTA DE SERVICII: PREPARARE Siliciul poros – PS –prin dizolvarea electrochimica a Si in solutii pe baza de HF

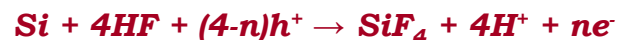
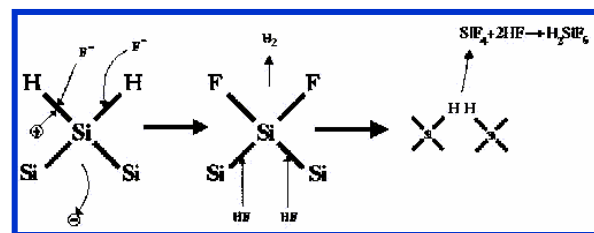


Celula de anodizare



Sistem A.M.M.T pentru corodare plachete de Si de 4 inch cu sursa programabila si cu software dedicat pentru inregistrarea profilului curent-timp.

- Concentratia electrolitului
- Densitatea de curent
- Tipul si nivelul dopantului
- Iluminare



AVANTAJE

- PS este un material cu cost redus de fabricatie;
- marimea porilor este poate fi monitorizata in functie de conditiile de preparare;
- suprafata mare / volum mic (suprafata interna 600 m2/cm3);
- chimia suprafetei este cunoscuta;
- compatibilitate cu tehnologia de de microfabricare a dispozitivelor pe Si;
- PS is biocompatibi si bioresorbabil (Si cu dimensiuni nanometrice), cu eliberare de acid silicic fara efecte toxice pentru organism.



L1: APLICATII PROPUSE

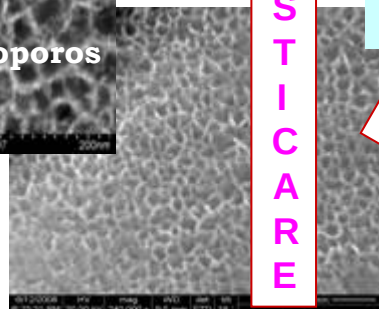
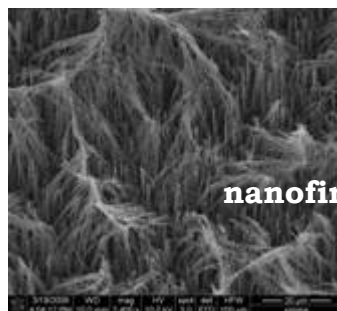
DIAGNOSTICARE

BIODETECTIE:

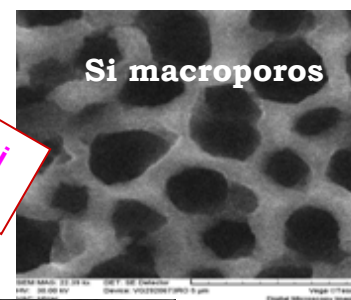
PS receptor: proteine, ADN, anticorpi, enzime, celule;
PS traductor de semnal Electric (conductanta, impedanta), (Electro)Chimic, Optic
 Luminescenta, Fosforescenta, Spectroscopie de reflexie interna, Spectroscopie de Interferenta Reflectometrica, Elipsometrie, Fluorescenta—intensitate, timp de viata Absorbanta, Raman Scattering, SERS, Rezonanta plasmonica

MATERIAL TERMOELECTRIC pentru dispozitive de conversie directa a caldurii in energie electrica

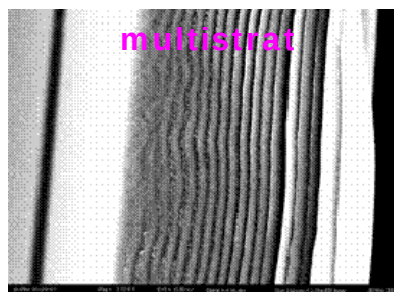
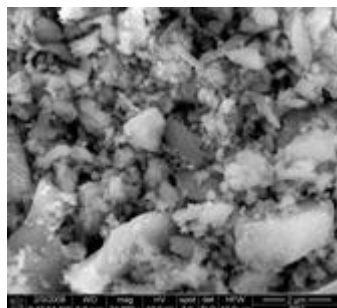
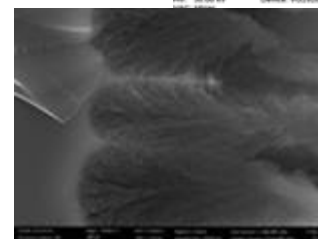
EMISIE IN CAMP



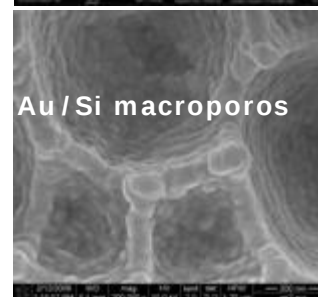
MICROARRAY-uri cu proteine



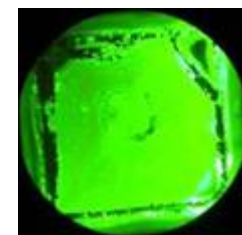
BIOSENZORI OPTICI



IMPREGNARE CU MEDICAMENTE DE INTERES TERAPEUTIC- ELIBERARE CONTROLATA



Substrat SERS



MATERIAL BIOCOMPATIBIL si BIODEGRADABIL



LABORATORUL DE MICROFOTONICA – L3

Sef de laborator: Dr. Dana Cristea
dana.cristea@imt.ro



L3: Activitati Cercetare-Dezvoltare

Activitate

- ☐ *Cercetare, educatie, training in domeniul micro si nanofotonicii*

Oferta de cercetare- domenii de intreres:

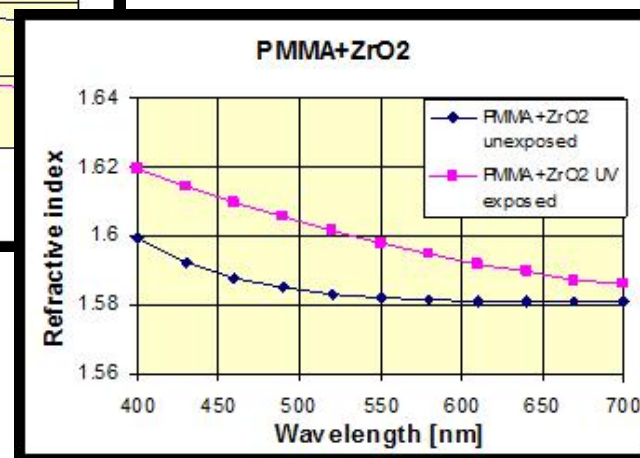
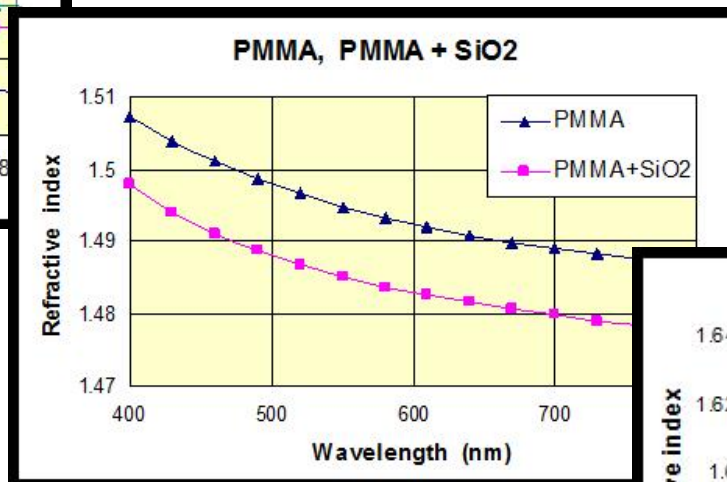
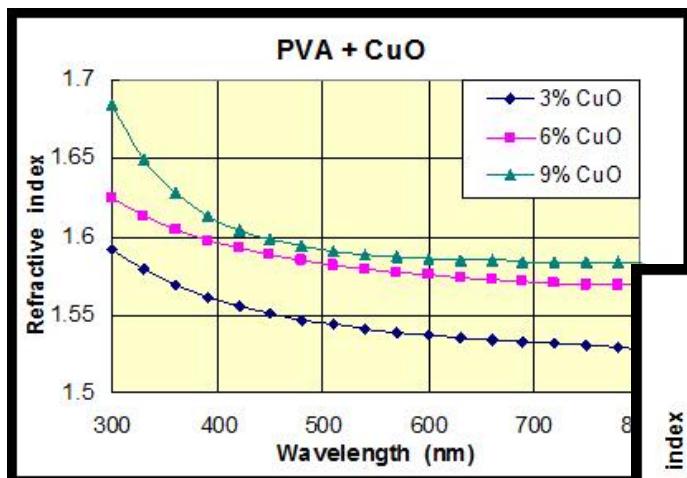
- ☐ Modelare /simulare /cad structuri micro si nanofotonicii (componete de optica integrate, dispozitivre optoelectronice, microsisteme opto-electro-mecanice)
- ☐ Dezvoltare noi materiale cu proprietati optice controlate (polimeri dopati, compusi hibridi, nanocompozite) *passive and active micro-nano-photonic structures,*
- ☐ *Tehnici de procesare polimeri pentru fabricatie pe scara larga*
- ☐ Componente micro-optice pentriu aparatura optica, microsenzori, microfluidica
- ☐ Optoelectronica transparenta
- ☐ Caracterizari optice si optoelectrice de materiale si structuri

Laboratorul de microfotonica are experienta in colaborari cu centre de cercetare si firme din tara si strainatate (proiecte nationale si europene FP6, FP7, colaborari bilaterale)



L3: Oferta cercetare - dezvoltare noi materiale

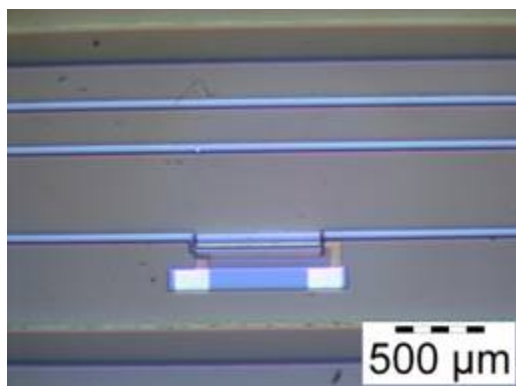
Materiale polimerice si hibride organic-anorganic cu proprietati optice controlate





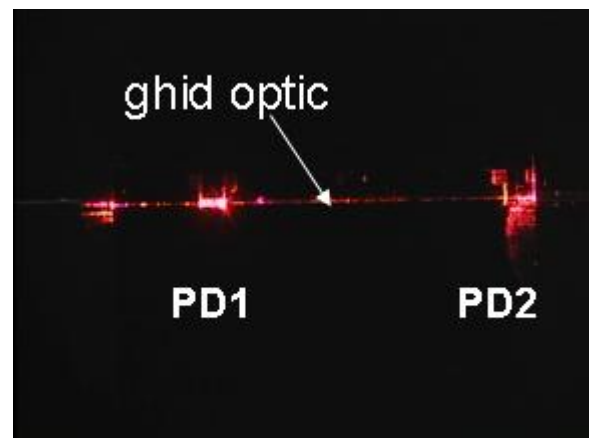
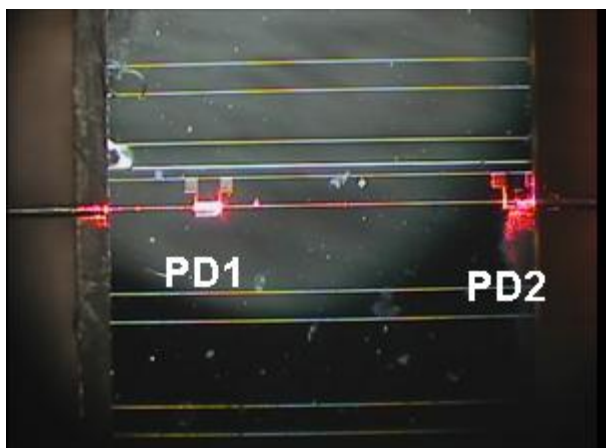
L3: Oferta cercetare - *Senzori cu detectie optica*

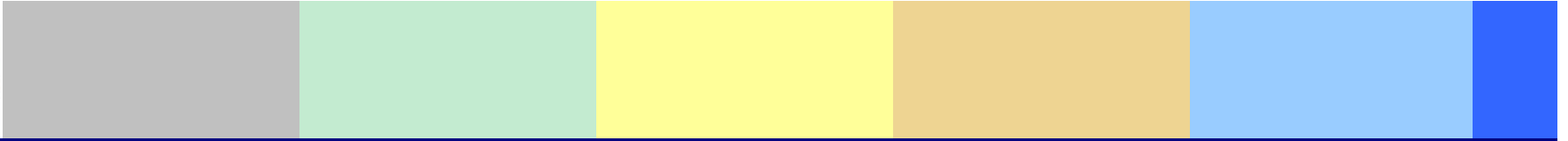
□ Cipuri integrate: ghid optic- fotodetector



Ghid optic din PMMA cuplat cu fotodiode

Semnalul optic detectat de a doua fotodioda (PD2) depinde de proprietatile optice ale mediului

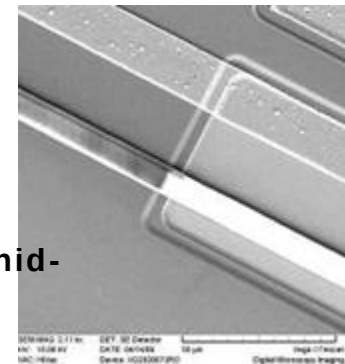
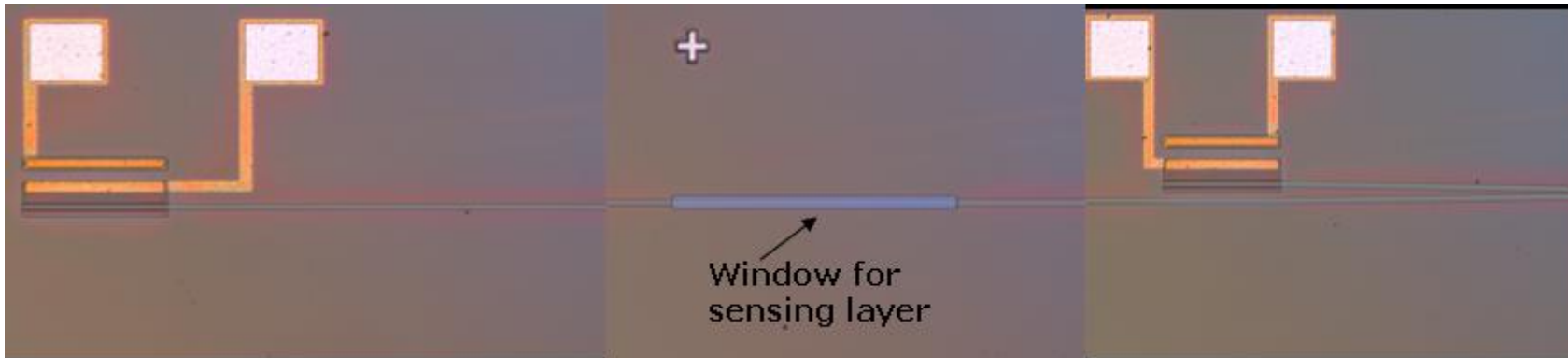




L3: Oferta cercetare - *Senzori cu detectie optica*

❑ Cipuri integrate: ghid optic- fotodetector

- **Gid SU-8 integrat cu fotodiode de Si**



Regiunea de cuplaj ghid-fotodioda

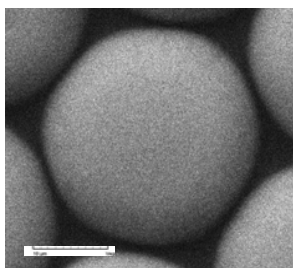


L3: Oferta cercetare -

Tehnologie de replicare micro si nano-structuri

Aplicatii in microoptica

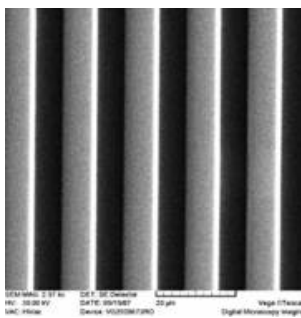
Componente optice cu detalii micronice si submicronice



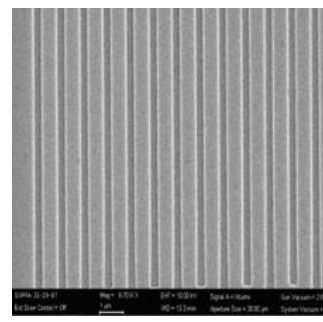
Microlentile (epoxi)
 $\phi = 20 \mu\text{m}$



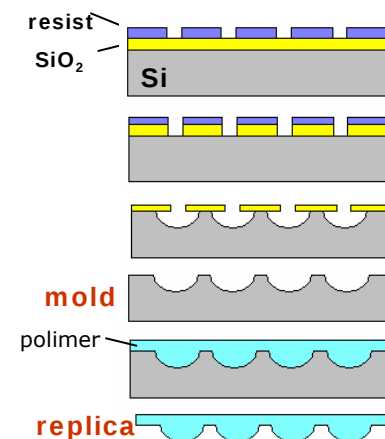
Lentila Fresnel $\phi = 20 \mu\text{m}$
Detaliul minim: $3 \mu\text{m}$



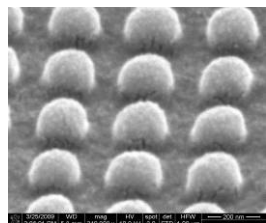
Retea de difracție
linia $8 \mu\text{m}$



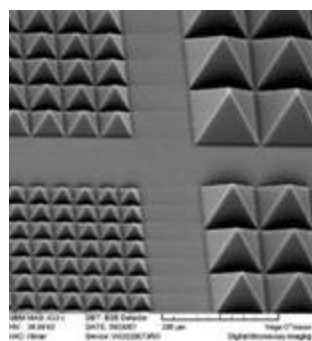
Retea de difracție
linia 200 nm



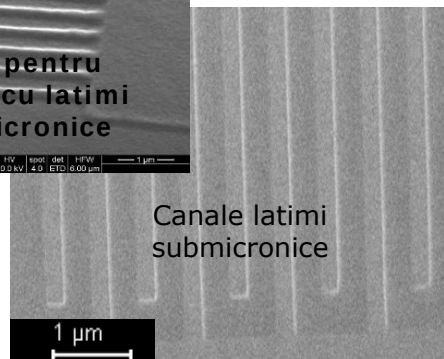
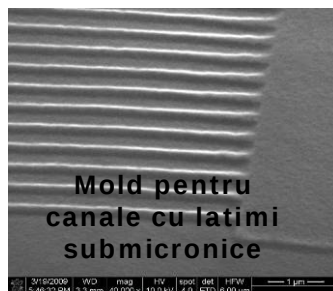
Aplicatii in microfluidica



lentile (epoxi)
 $\phi < 200 \text{ nm}$



Microprisme



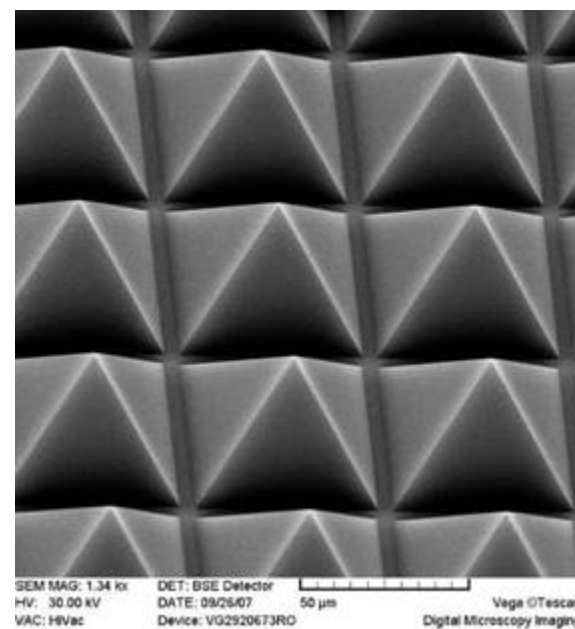
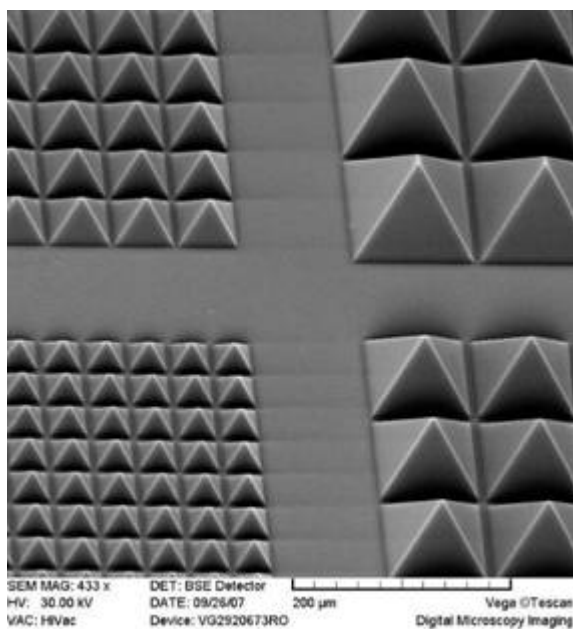
Microcanale





L3: Oferta cercetare - *Componente micro-optice la comanda*

Pyramids in PMMA

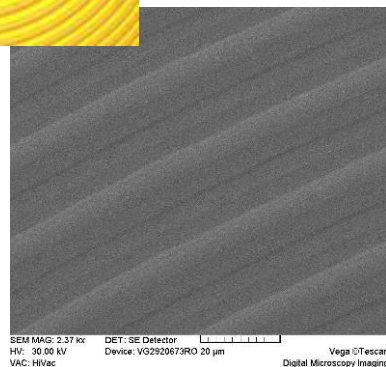
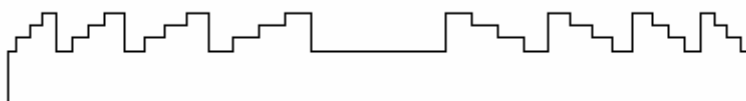




L3: Micro-optica - *elemente optice difractive binare si multi-nivel la comanda*

Exemple

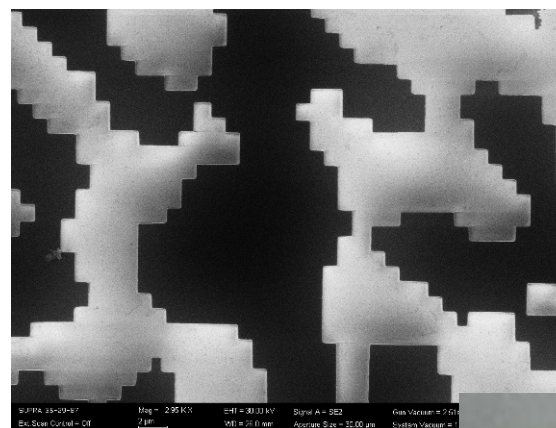
Lentile Fresnel cu 4 nivele,
distanța focală 6 cm



SEM MAG: 2.37 kx
HV: 30.00 kV
VAC: HVac
DET: SE Detector
Device: VG2920673RO 20 µm
Vega/OTescan
Digital Microscopy Imaging

Elemente optice difractive
generatoare de configurații

(sigle, elemente de siguranță, etc.)



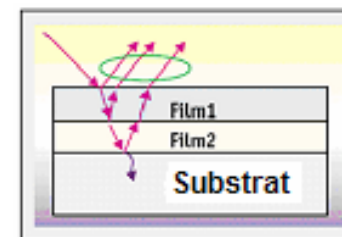


L3: Servicii științifice - *Elispometrie spectrala*

Caracterizarea mono si multistraturilor subtiri din diverse materiale: oxizi metalici, polimeri, materiale compozite.

Informatii carese pot obtine prin elipsometrie:

- * indicele de refractie (n), ϵ - constanta dielectrica, k-coeficientul de extinctie functie de lungimea de unda pe domeniul spectral UV-VIS-NIR;
- * grosimea filmelor subtiri si a depunerilor multistrat;
- * compozitia straturilor neomogene
- * porozitatea
- * rugozitatea la interfata



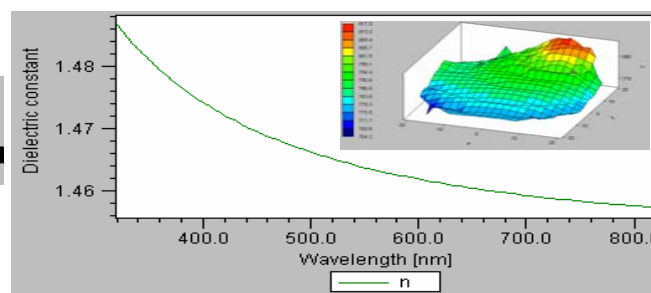
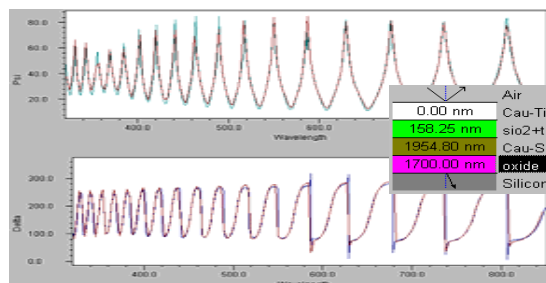
Proba tipica pentru analize elipsometrice

Aplicatii: acoperirile optice pentru sticle cu proprietati optice si termice controlate, in optica medicala , depuneri si corodari controlate de straturi subtiri protectoare de materiale anorganice si organice.

Echipament: Elipsometru spectral SE XUV 800, Sentech, Germania

Caracteristici:

- domeniul spectral (240-850) nm;
- diametru microspot 0.2 mm;
- software de achizitie si analiza date: SPECRRARY II /WINDOWS
- posibilitate de mapare XY cu vizualizare 2D- 3D a grosimii straturilor.



Serviciu oferit de laboratorul OPTOLAB aflat in curs de acreditare conform standardului ISO 17025

Persoane de contact:
Dr. fiz. Munizer Purica
 munizer.purica@imt.ro,
F. Comanescu
 florin.comanescu@imt.ro



L3: Servicii stiintifice - *Spectrometrie RAMAN*

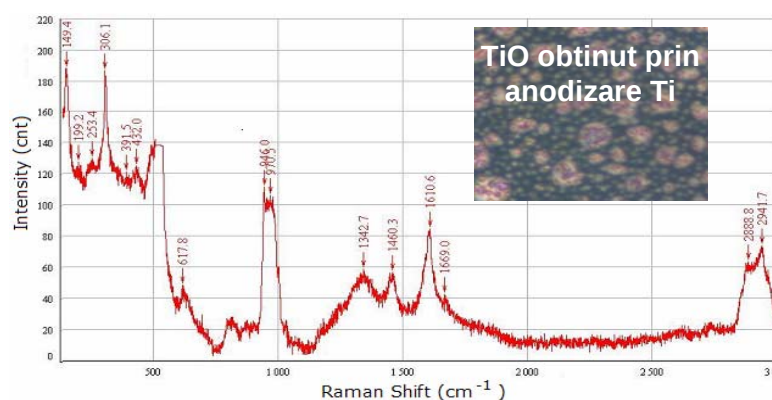
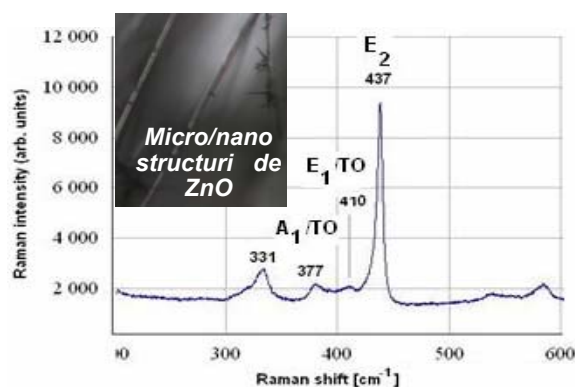
Aplicatii: analize fizico-chimice de materiale micro/nano structurate :

- ❑ identificarea compusilor chimici si caracterizarea structurii moleculelor;
- ❑ **determinarea compozitiei si fazei** materialelor compozite;
- ❑ **determinarea** cristalinitatii si a compozitiei aliajelor semiconductoare oxidice
- ❑ **caracterizarea** polimerilor si a nanocompozitelor polimerice;
- ❑ **detectie de** molecule chimice si biologice **self asamblate pe substrate functionalizate** prin utilizarea tehnicii **SERS** (Surface Enhanced Raman Spectroscopy)

Echipament: Spectrometru micro-Raman Lab Ram HR800 - HORRIBA JOBIN YVON

Caracteristici:

- microscop confocal
- rezolutia spectrala: 0.3cm⁻¹/pixel, cu 2 retele de difractie (1800 si 600 gr/mm)
- domeniul pentru frecventele de lucru: 50 – 4000 cm⁻¹;
- Softul specializat- Labspec utilizat pentru achizitia si maparea datelor



Serviciu oferit de
**laboratorul OPTOLAB aflat in
curs de acreditare conform
standardului ISO 17025**

Persoane de contact:
Dr. fiz. Munizer Purica
(munizer.purica@imt.ro),
F. Comanescu
(florin.comanescu@imt.ro)



L3: Servicii stiintifice - Caracterizare

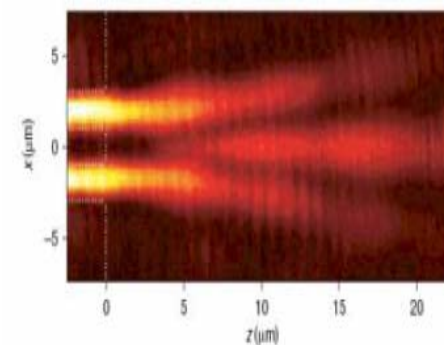
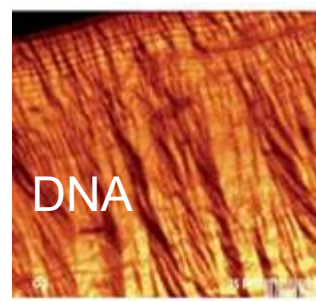
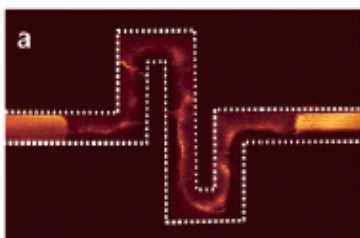
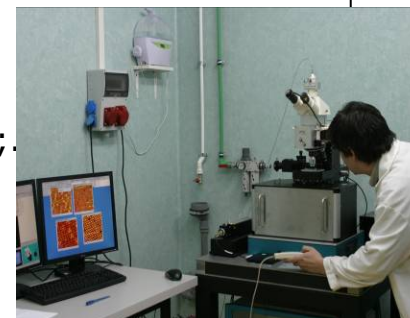
Near Field Scanning Optical Microscopy (Alpha300 S System)

Moduri de operare

- ❑ Microscopie in camp optic apropiat: transmisie, reflexie, colectare, fluorescenta;
- ❑ Microscopie confocala: transmission, reflection, fluorescence;
- ❑ AFM- mod contact si alternativ contact;

Aplicatii

- ❑ Nanotehnologie, nanofotonica, plasmonica: vizualizare structuri cu detalii submicronice (cu rezolutie sub limita de difractie);
- ❑ Caracterizare componente optoelectronice active;
- ❑ Caracterizare structuri fotonice- vizualizarea propagarii undelor;
- ❑ Caracterizari microfluidica, biologie, materiale nanostructurate;
- ❑ Single molecule detection;

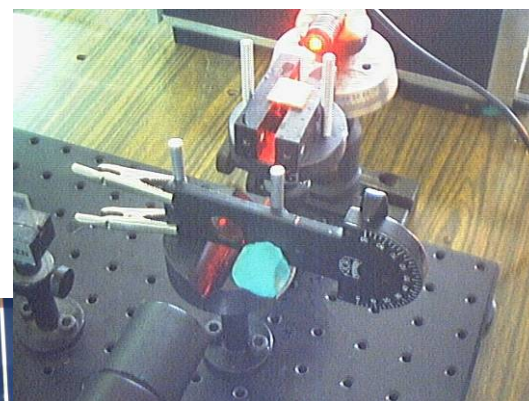




L3: Servicii stiintifice - *Caracterizare*

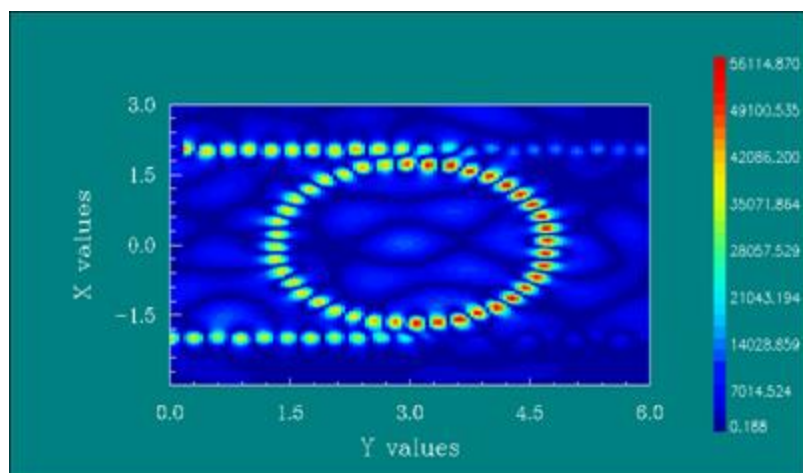
Caracterizare componente optoelectronica si circuite fotonice integrate (domenii VIS, IR)

- ❑ Caracterizari componente optoelectronice;
- ❑ Caracterizari circuite fotonice integrate;
- ❑ Caracterizari chemo si biosenzori;

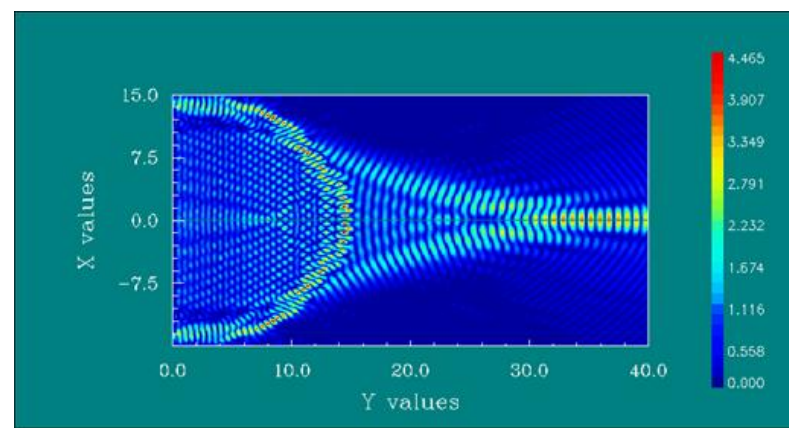




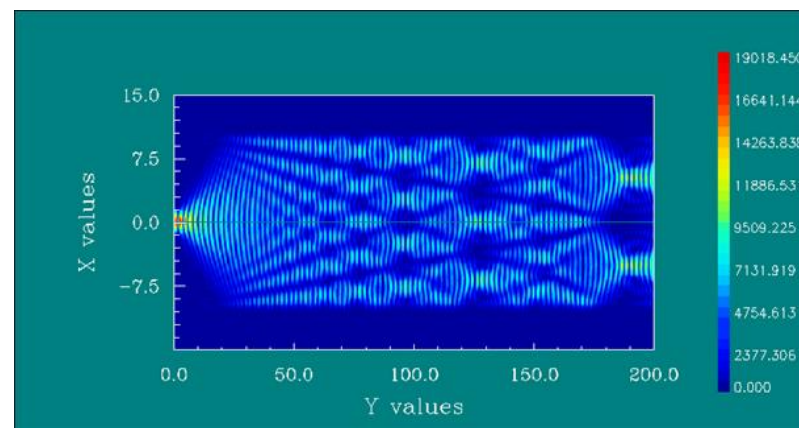
L3: Servicii științifice - *Modelare / Simulare / proiectare*



Filtru cu rezonator inelar



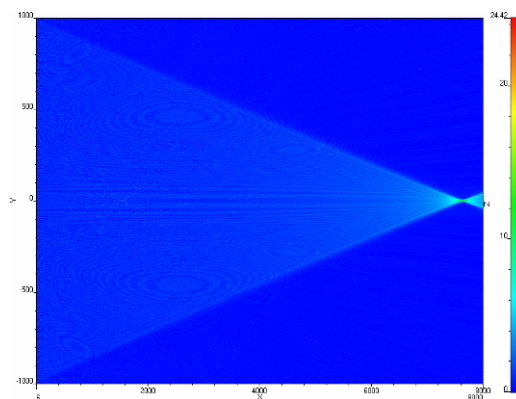
Microlentila



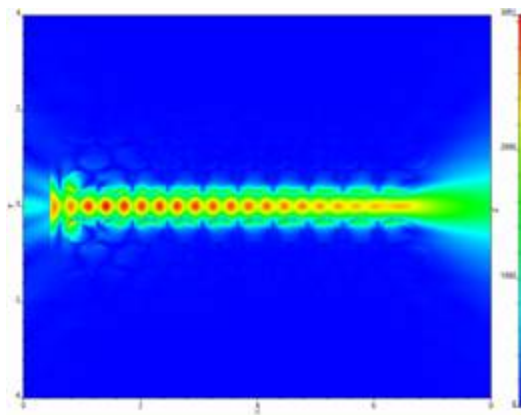
Cuplor multimodal



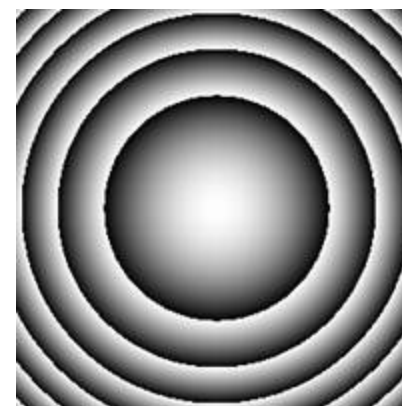
L3: Servicii științifice - *Modelare / Simulare / proiectare*



Simularea propagării radiației optice printr-o lentilă Fresnel cu 4 nivele (Opti-BPM).



Simularea propagării radiației printr-un ghid pe baza de cristale fotonice cu structură hexagonală



Structura de lentilă Fresnel cu relief continuu – mască proiectată cu programul (3 Lith)



L3: Servicii stiintifice - *Instruire*

EDUCATIE SI TRAINING IN MICROPHOTONICA

Programe pentru:

- ☐ Studenti
- ☐ Masteranzi (**program de master in Optoelectronica in cooperare cu UPB**)
- ☐ Doctoranzi
- ☐ Specilaisti

Experienta in proiecte internationale axate pe instruire:

- ☐ Retea de Training Marie-Curie- **ASSEMIC**;
- ☐ Proiect tip Leonardo da Vinci – **MICROTEACHING**;



**Institutul National de Cercetare - Dezvoltare pentru Microtehnologie
(IMT- Bucuresti)**

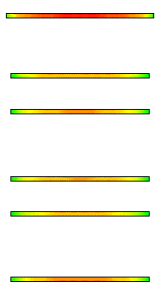
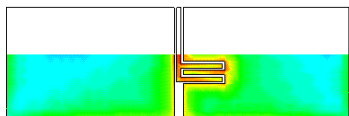
LABORATORUL DE MICROSTRUCTURI, DISPOZITIVE SI CIRCUITE DE MICROUNDE – L4

Sef de laborator: Dr. Alexandru Muller
alexandru.muller@imt.ro

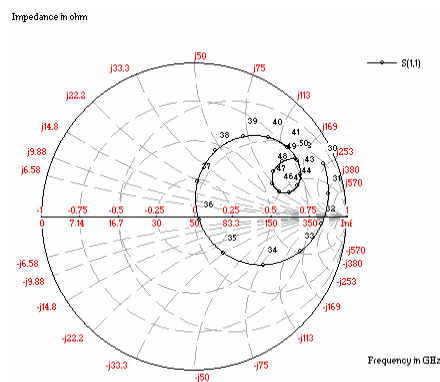
Oferta de Servicii



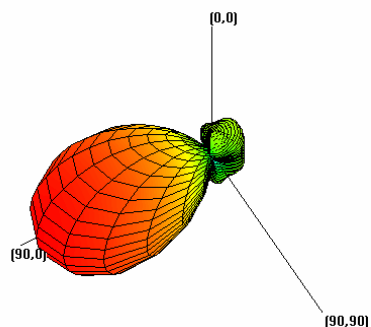
L4: Oferta de servicii - Modelare electromagnetica si proiectare de filtre, antene, module receptoare si front-end-uri in domeniul microundelor si undelor milimetrice



Distributia densitatii de curent pentru antena Yagi-Uda de 77 GHz



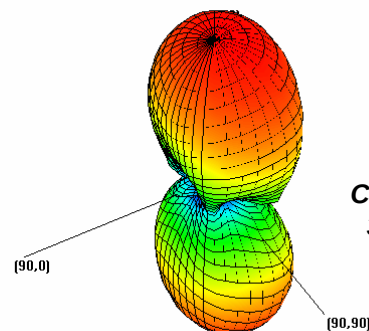
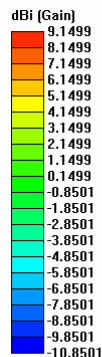
Impedanta de intrare a unei antene slot dublu foldat pentru 45 GHz



Caracteristica de radiatie 3D simulata pentru antena Yagi-Uda la 60 GHz

Pachetul software de simulare electromagnetica (EM) tridimensionala IE3D de la Zeland Ltd.

Zeland IE3D este un pachet de programe de simulare EM de tip "full-wave" bazat pe determinarea distributiilor densitatii de current, pentru structurile 3D metalice cu configuratie arbitrara. Analizele EM includ dispersia, pierderile, discontinuitatile, undele de suprafata, modurile superioare. Se determina parametrii S, diagrame de radiatie, distributiile de camp EM. Structurile pot fi proiectate automat prin optimizare.



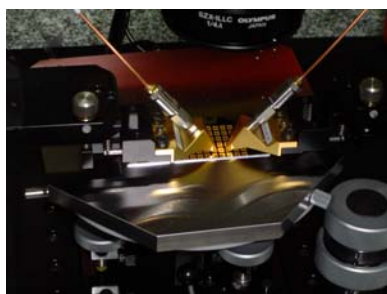
Caracteristica de radiatie 3D a antenei slot dublu foldat la 45 GHz



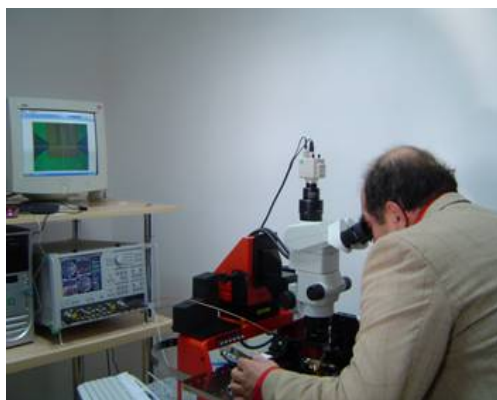
L4: Oferta de servicii - Caracterizare in microunde si unde milimetrice "on wafer" pana la 65 GHz (din iunie pana la 110 GHz)



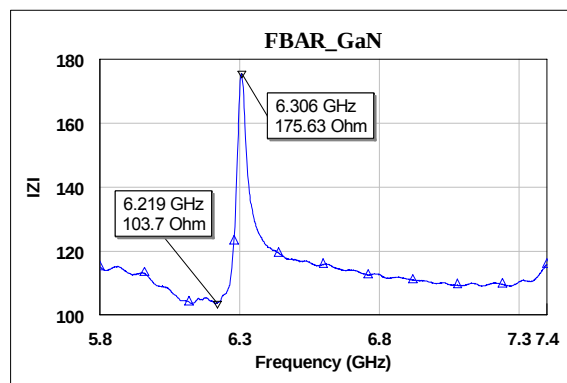
*Proberul „on wafer”
PM5 de la Suss
Microtec*



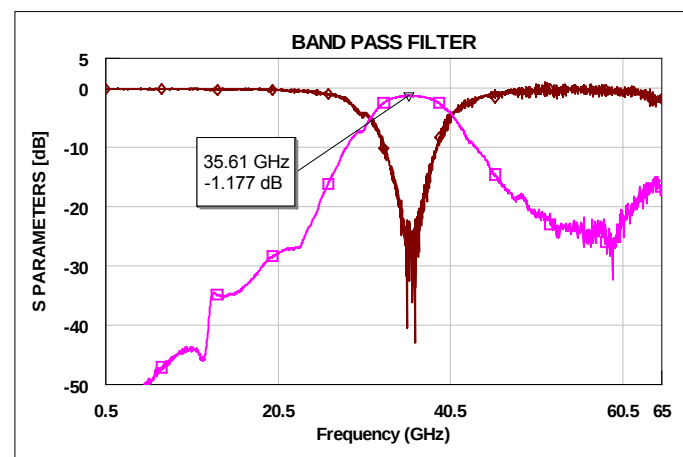
Detaliu cu suportul „on wafer”



*VNA de 65 GHz (de la
Anritsu) model 37397D
cuplat cu proberul PM5 de
la Suss Microtec*



Impedanta Z obtinuta din masuratorile de parametrii S pentru un rezonator FBAR (film bulk acoustic wave resonator) cu frecventa de rezonanta de 6.3 GHz, realizat pe o membrana de GaN de doar $0.54\mu\text{m}$ grosime



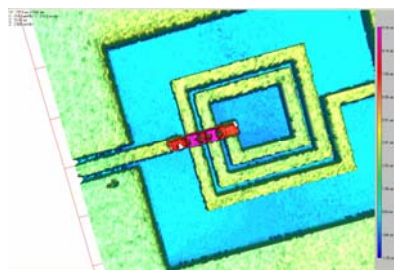
Masuratori de parametrii S pentru filtrul trece banda de 35 GHz suspendat pe membrana dielectrica din $\text{SiO}_2/\text{Si}_3\text{N}_4/\text{SiO}_2$ de grosime de $1.4\mu\text{m}$, obtinuta prin microprelucrarea siliciului.



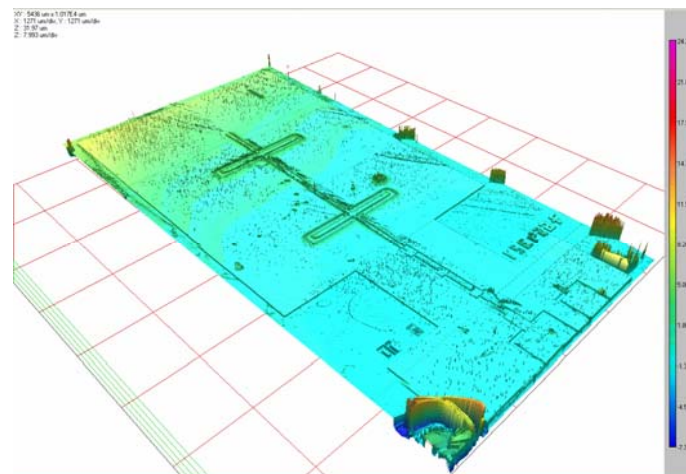
Profilare 3D a structurilor microprelucrate prin interferometrie in lumina alba (WLI – while light interferometer)



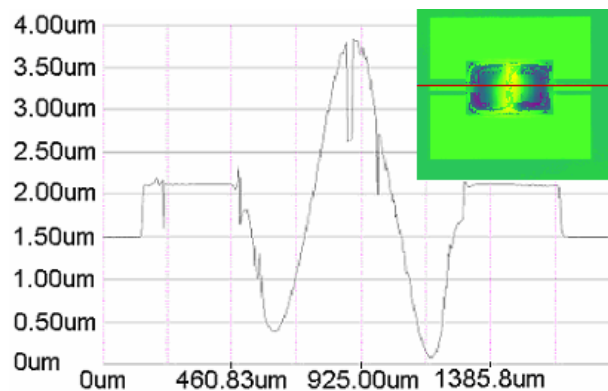
**Interferometrul Photomap 3D
Standard 2006 (FOGALE NANOTECH)**



**Detaliu cu inductorul suspendat pe
membrana dielectrica de $1.4\mu\text{m}$ grosime
dintr-o structura de filtru pentru 5.2 GHz.**



**Imagine 3D a unei structuri de receptor
microprelucrat integrat monolitic pentru 60 GHz
realizat pe GaAs**



**Deflexia membranei de GaN a structurii de
FBAR functie de coordonata**

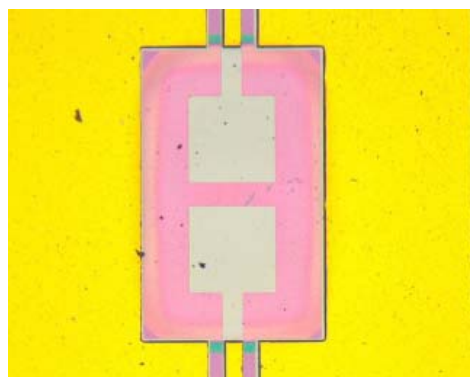




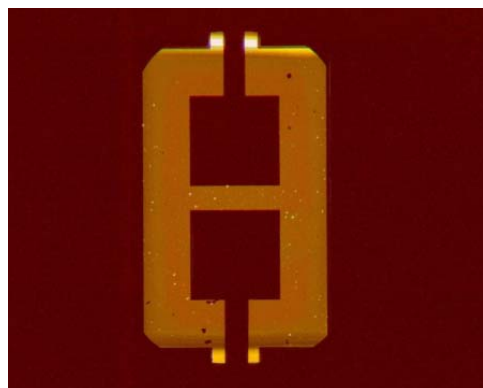
Caracterizare in microunde

IMT - FORTH, Heraklion
Iulie 2008

GaN FBAR cu rezonanta la 6.3 GHz
Membrana subtire de GaN: 340 nm (GaN)
+200nm (buffer)
50nm metalizare Mo

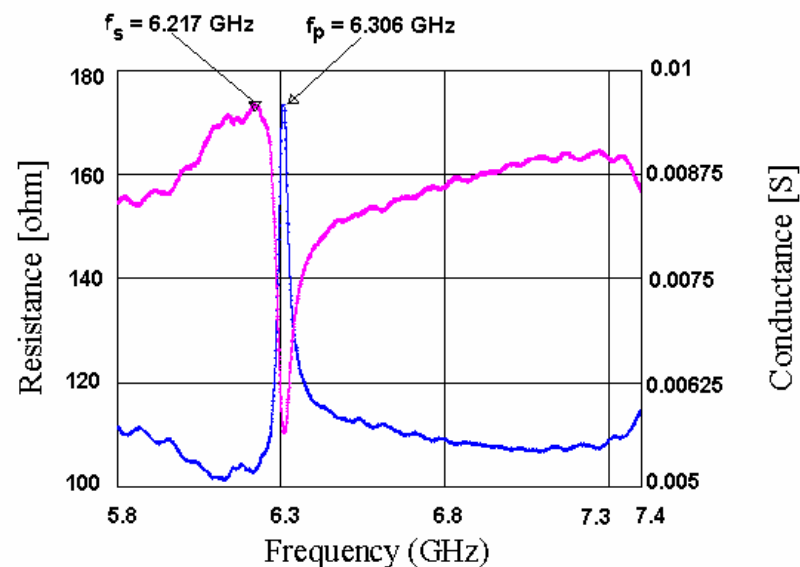


Vedere de sus cu iluminare deasupra structurii



Vedere de jos cu iluminare deasupra structurii

Structura finala de rezonator FBAR

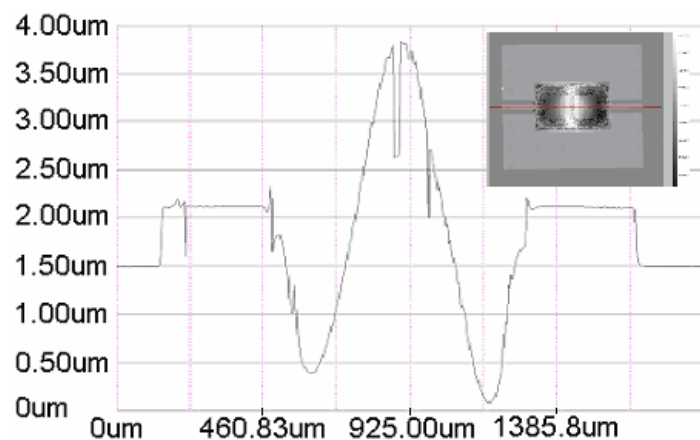
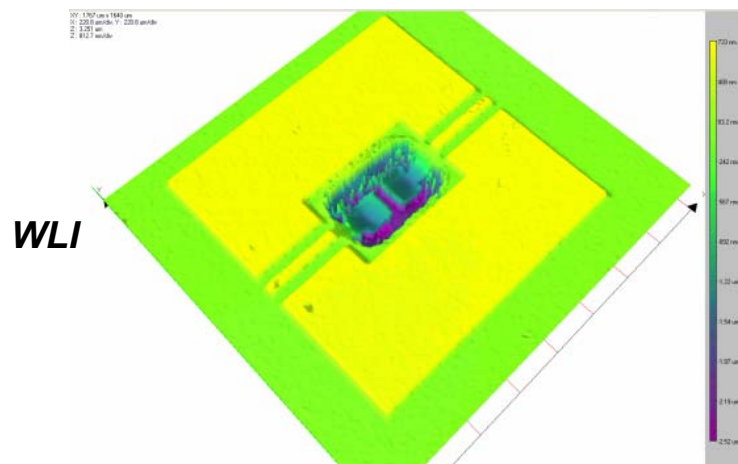


Masuratori de caracterizare in microunde efectuate cu sistemul de masura "on wafer" din laborator, sistem achizitionat prin programul PN II Capacitati



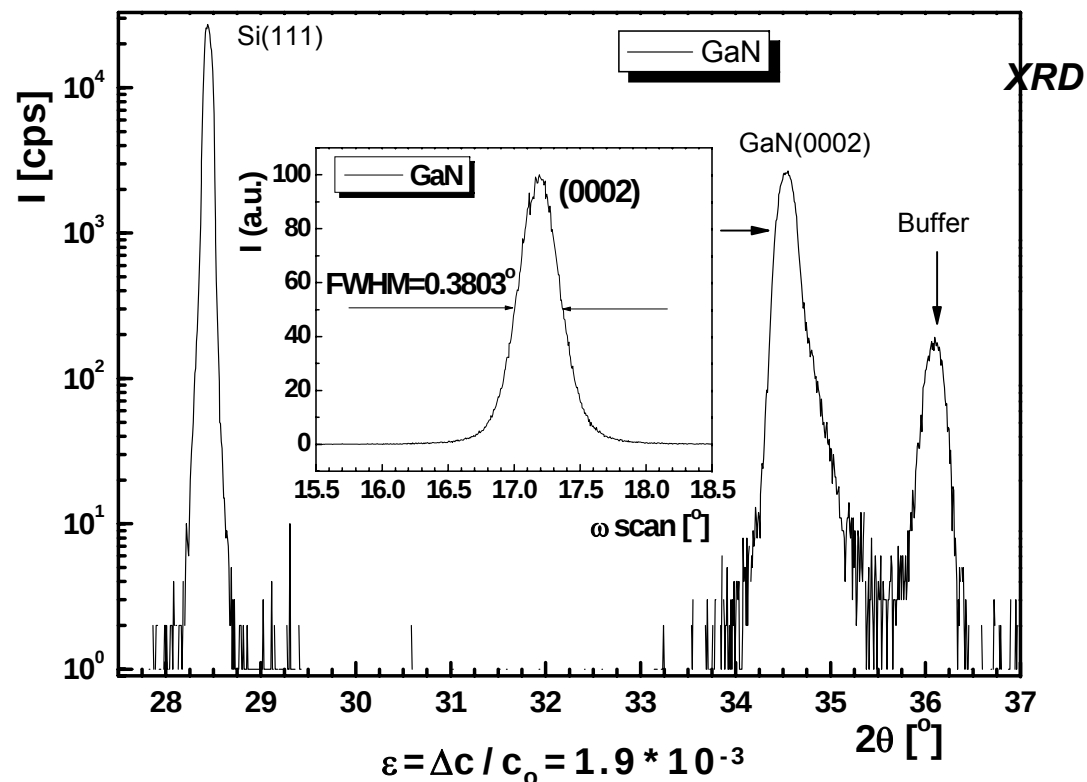
Caracterizari microfizice ale membranei foarte subtiri de GaN care sustine rezonatorul FBAR

Interferometrie in lumina alba



Deflexia maxima a membranei este de $2.7\mu\text{m}$, datorita metalizarii de molibden

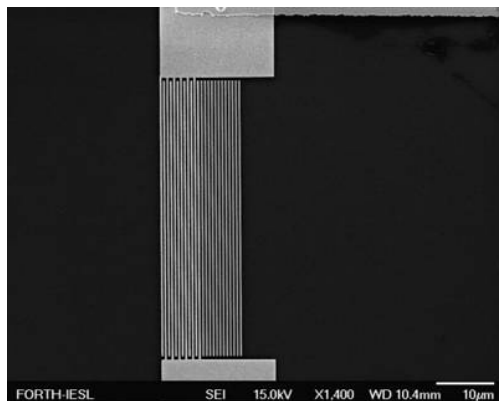
Difractie de raze X



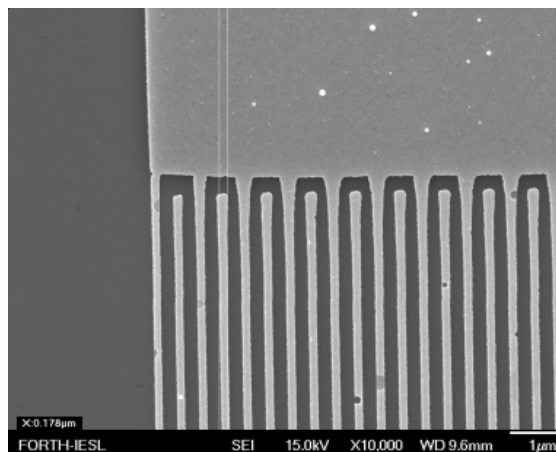
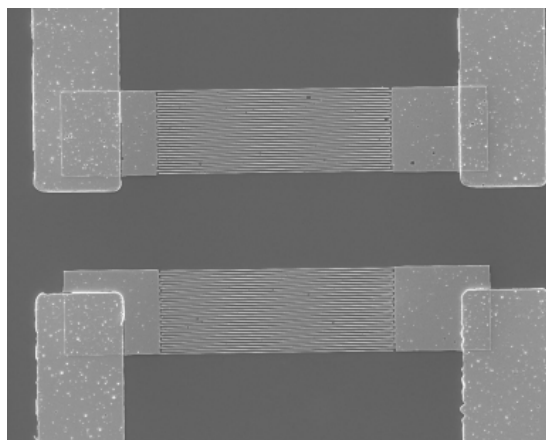
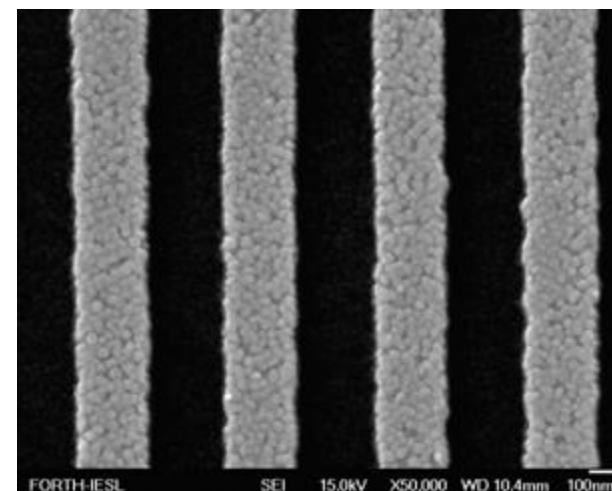
Stressul in retea e foarte mic in ciuda MOCVD de GaN pe siliciu, ceea ce explica stabilitatea mecanica a membranei foarte subtiri



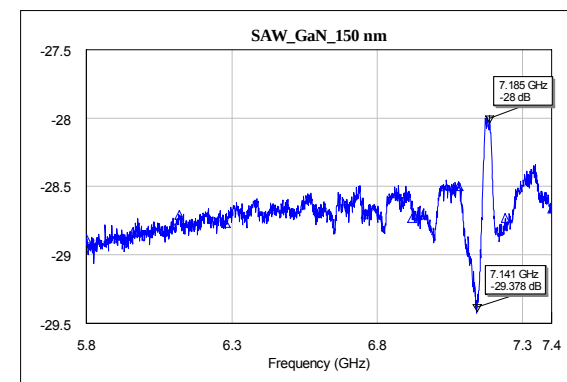
Caracterizare in microunde



Structura SAW realizata pe AlN pentru domeniul GHz. Digiți și interdigiți de 300 nm obtinuti cu echipamentul de nanolitografie Vega-SEM și Elphy Plus EBL



Ultima ora: Structura SAW realizata pe GaN Digiți și interdigiți de 150nm obtinuti la IMT pe echipamentul "E-Line"
Rezonanta la 7 GHz pe GaN IMT- FORTH 2009



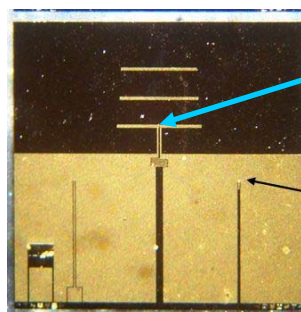
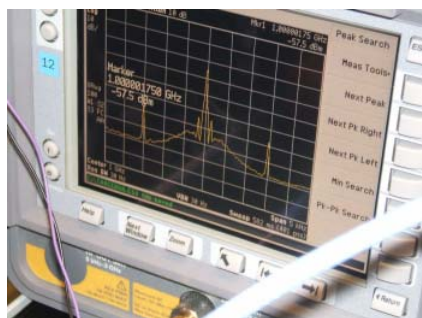


Caracterizare in microunde: Modul de receptie integrat monolitic pe membrana de GaAs pentru 60 GHz cu antena Yagi-Uda si Modul de receptie integrat hibrid pentru 77 GHz cu antena slot dublu foldat pe siliciu

O noua aplicatie: Sistem de identificare in unde milimetrice (MMID) utilizand receptorul ca "tag"

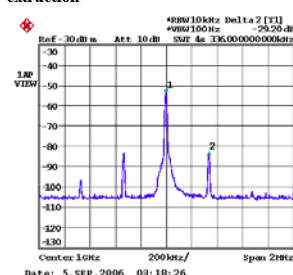
• Conceptul MMID a fost demonstrat pentru distante de 0.5 ... 2.5 m

Structura modului receptor cu antena Yagi

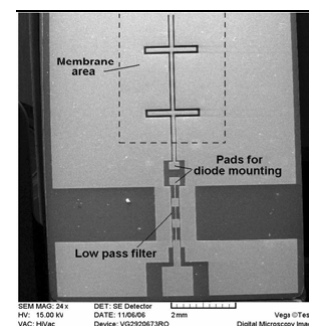


Schottky diode

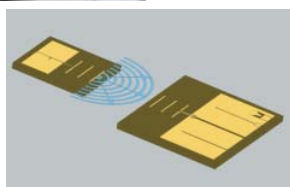
Test membrane supported Schottky diode for parameter extraction



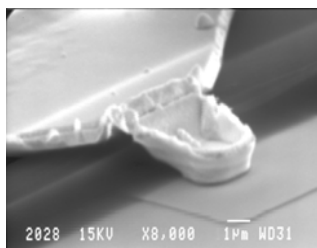
Spectrul de imprastiere (backscattered) al receptorului la 1.04 m. Puterea de transmisie = 34 dBm EIRP.



Imagine SEM a receptorului pentru 77 GHz (inainte de montarea diodei Schottky).



Polyimide bridge



Detalii cu zona diodei Schottky

Utilizand analizorul de spectru si generatorul pana la 110 GHz astfel de masuratori vor putea fi efectuate in IMT



**Institutul National de Cercetare - Dezvoltare pentru Microtehnologie
(IMT- Bucuresti)**

LABORATORUL DE MODELARE, SIMULARE SI PROIECTARE ASISTATA DE CALCULATOR – L5

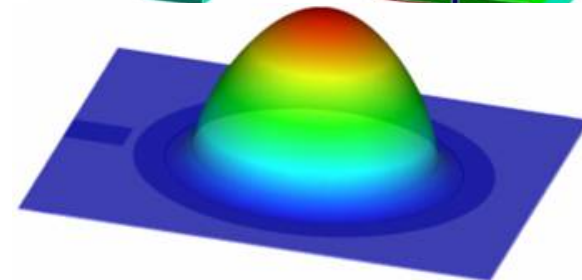
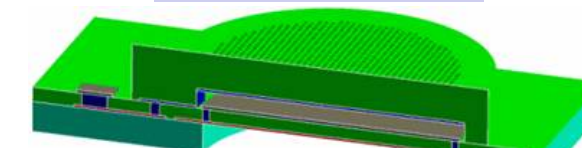
**Sef de laborator: Dr. Raluca Muller
raluca.muller@imt.ro**



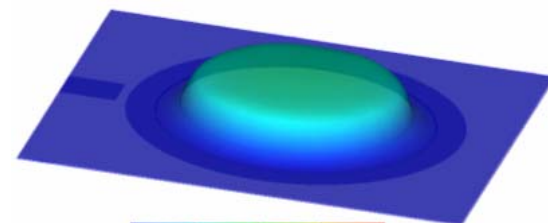
L5: Laboratorul de Modelare, Simulare si Proiectare Asistata de Calculator

- Modelare si analiza de camp electric, magnetic, termic, mecanic pentru sisteme microelectromecanice (MEMS)
- Analize cuplate electro-mecanic, termo-electro-mecanic
- Modelare si analiza de *sisteme microfluidice*: curgeri sub presiune sau gradient de temperatura, actuare electrocinetica, simulari droplet/bubble
- Proiectare si simulare de componente microfluidice pentru cipuri cu aplicatii *biomedicale*

Microfon capacitiv

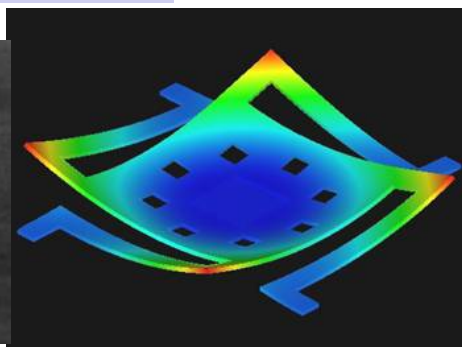


Displacement U_z : -7.1E-06 1.3E-02 2.7E-02 4.0E-02 5.4E-02

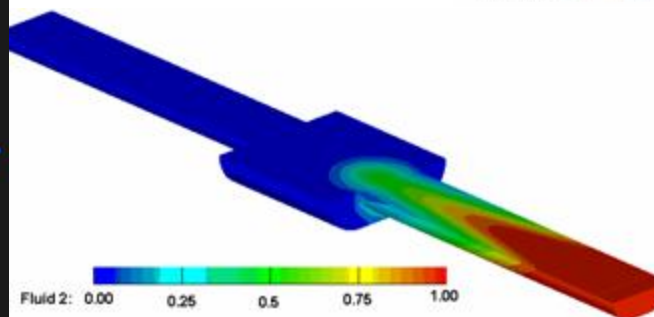


Displacement U_z : -7.1E-06 1.3E-02 2.7E-02 4.0E-02 5.4E-02

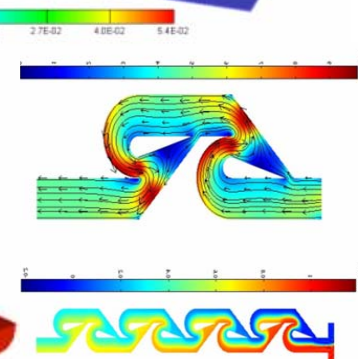
Microreflector Si



Mixer microfluidic



Fluid 2: 0.00 0.25 0.5 0.75 1.00





L5: Sisteme software de analiza numerica

❑ COVENTORWARE 2008.010

Modele 3D pentru dispozitive ready-to-manufacture

- ◆ analiza de micropompe si microvalve (actuale electrostatica/piezoelectrica/pneumatica/electroosmotica)
- ◆ propagari in microcanale, micromixere, microfiltre
- ◆ regim static si tranzitoriu
- ◆ fenomene cuplate diverse
- ◆ proiectare de masti si simulare de procese tehnologice

❑ ANSYS 11.0

Modelare, simulare, analiza si proiectare in MEMS, MOEMS, microfluidica; scara micro - macro

❑ COMSOL 3.4

Simulare de fenomene si procese din fizica, inginerie, chimie

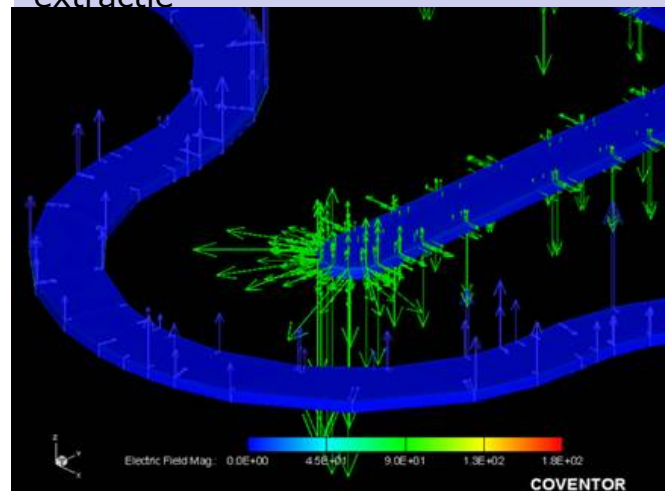
❑ MATLAB R2008a

Calcul tehnice, achizitie si analiza de date, vizualizare

❑ Mathematica 7

❑ OriginPro 8

Camp electromagnetic intr-o celula de extractie



Microfiltru pentru sisteme lab-on-chip

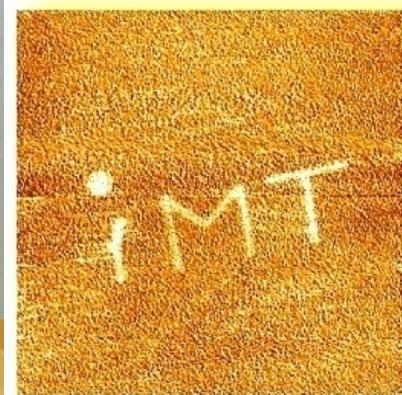




Alte echipamente

Nanoprinting System

Enables deposition
of tracks of various
materials
(polymers, sol-gel
precursors,
nanopowder,
complex molecules,
quantum dots) with
a thickness down to
30 nm.





Fully programmable for on-wafer/structure sourcing and measuring of DC voltage and current simultaneously.

4200-SMU power: 2.2W
(max.105mA, 210V).

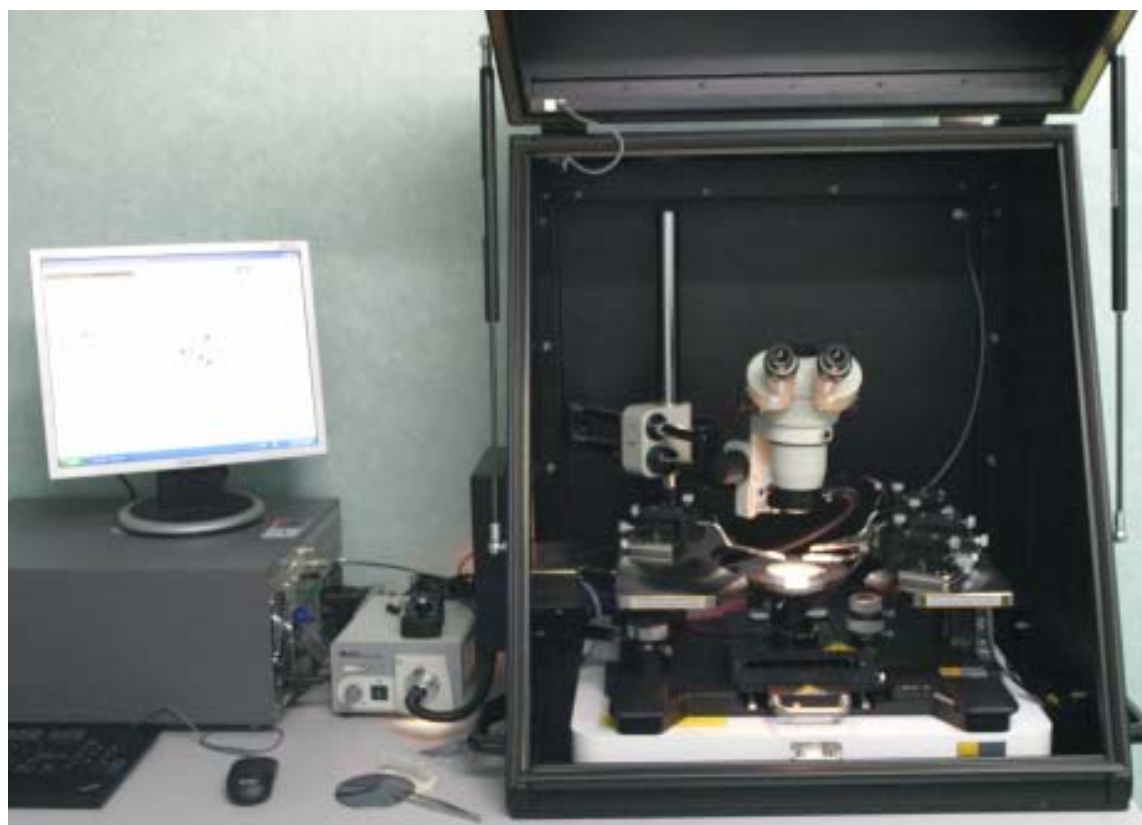
Per SMU preamplifier: 4200-PA with maximum measurement resolutions:
0.1fA, 5 μ V.

Shielded manual probe station with 4 triaxial cable manipulators.

Measurements on wafers and substrates up to 150 mm (6").

Positioning resolution:
3microns.

Semiconductor Characterization System with Manual Probe Station





**Institutul National de Cercetare - Dezvoltare pentru Microtehnologie
(IMT- Bucuresti)**

LABORATORUL DE MICROCARACTERIZARE FIZICA SI NANOSTRUCTURARE – L6

**Fiz. Adrian Dinescu
adrian.dinescu@imt.ro**



L6: NanoScaleLab

- ❑ Imagistica 2D si 3D de inalta rezolutie
 - **SEM, AFM, STM, LFM, Phase, Force Spectroscopy**
- ❑ Structurare la scara micro/nanometrica
 - **Nanolitografie cu fascicul de electroni (EBL)**
 - **Depunere indusa prin fascicul electronic, la scara nanometrica (Pt, W, SiO₂)**
 - **Corodare indusa prin fascicul electronic, la scara nanometrica (C, SiO₂)**
- ❑ Caracterizari mecanice de inalta rezolutie
 - **nanoindentare**





L6: Echipamente NanoScaleLab

- ❑ Electron beam lithography and nanoengineering workstation - Raith / e-Line
- ❑ Scanning Probe Microscope - NT-MDT / NTEGRA Aura
- ❑ Scanning electron microscopy - FEI Company / Nova NanoSEM 630; Tescan / Vega LMUII
- ❑ Nano Indenting characterization platform - Agilent Technologies / Nano Indenter G 200

Aplicatii

- profilometrie de rezolutie • evaluari/optimizari pentru acoperiri chimice, curatiri, slefuiri • analize de particule si monocristale • studii de microstructura (farmaceutica, polimeri) • studii morfologice (biologie) • nanometrologie • defectoscopie
- nanostructuri (nanolitografie, depunere, corodare) • caracterizari ale mecanicii suprafetelor





Scanning Probe Microscope (SPM)

Various techniques

AFM, STM, LFM, Phase Imaging,
Force Modulation, Force
Spectroscopy

Environments:

air, liquid, controlled gaseous
atmosphere, low vacuum

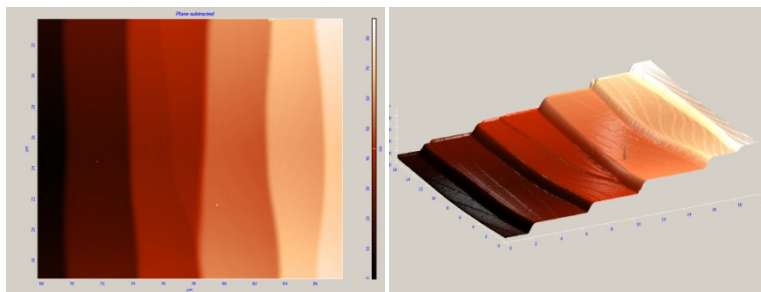
Scan range:

100x100

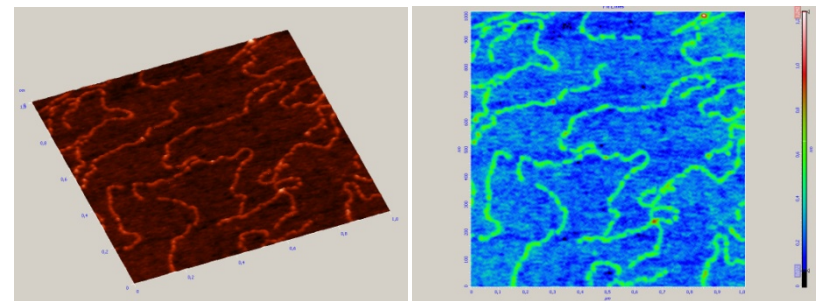
Noise level:

XY: 0,3 nm, Z: 0,06 nm

Non-linearity in X, Y with closed-
loop sensors:
< 0.15 %



AFM image of step patterned Si.
Individual step height: 15 nm

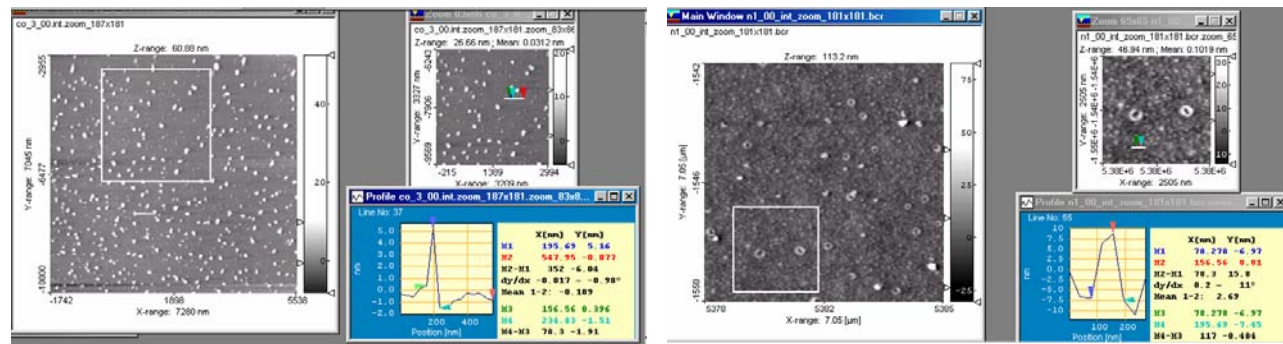


AFM image of linear DNA molecules
deposited on freshly cleaved mica.

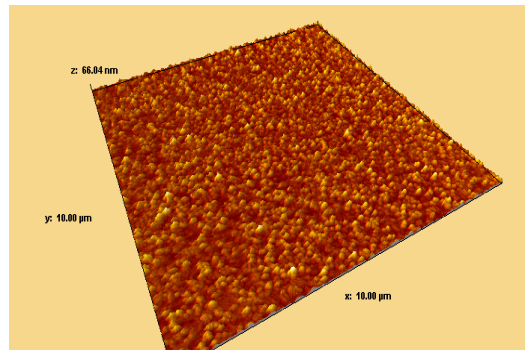
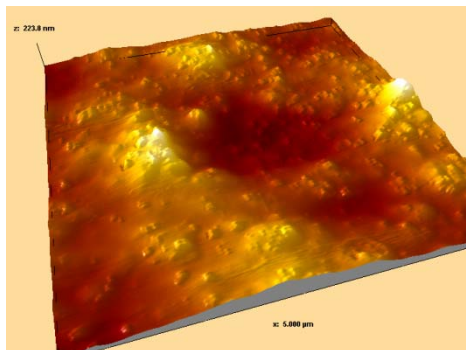


Scanning Probe Microscope (SPM)

- **AFM analysis:** nanoscale morphology of thin films and quantitative analysis of roughness parameters



Nanostructured polymer film prepared by sol-gel process: automatic AFM-based analysis revealing the directional distribution of nanoparticle sizes



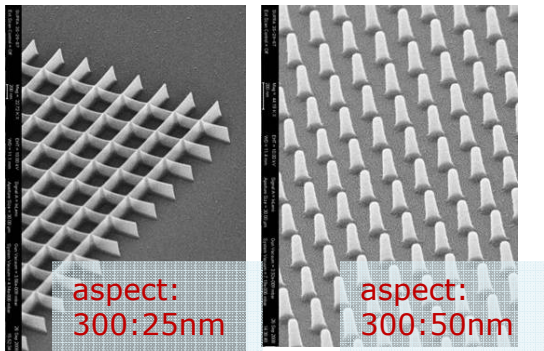
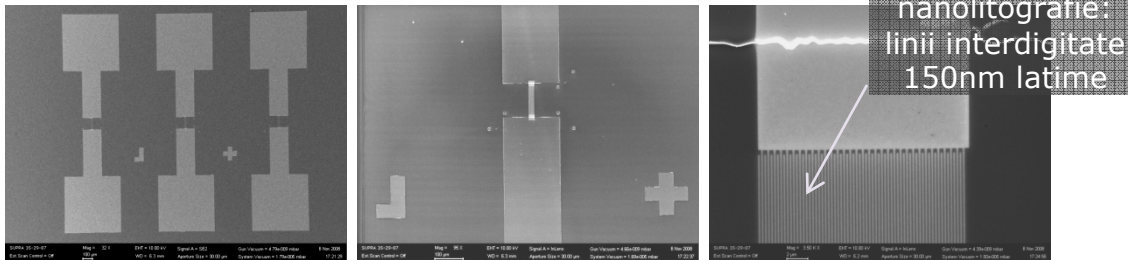
AFM images of various coatings: elastomer for microsensors, PVK on ITO substrate for organic LED applications



Electron beam lithography and nanoengineering workstation

- high resolution FE SEM
- e-beam lithography
- e-beam induced deposition (EBID)
- e-beam induced etching (EBIE)
- nanomanipulation

Nanostructurare de tip mix-and-match: **detector UV** de tip metal-semiconductor-metal (**linii interdigitate** de 150 nm latime)



Matrici de pereti si varfuri de Si cu factor de aspect ridicat, cu aplicatii in NEMS



Thermal assisted field emission gun

Stage:
laser interferometer;
100mmx100mm;
2nm resolution

Minimum line width:
< 20nm

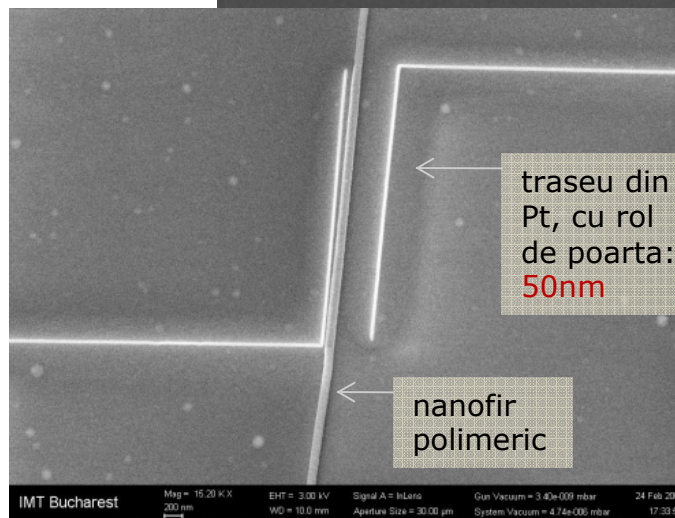
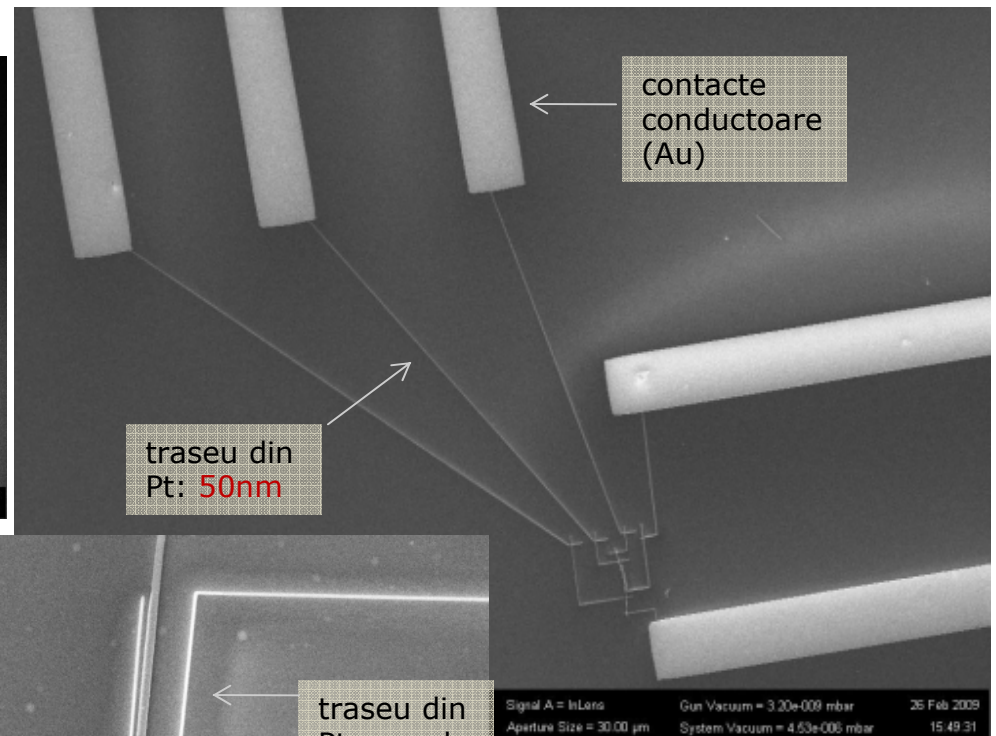
Stitching accuracy:
40nm



Electron beam lithography and nanoengineering workstation



Nano-depunere de trasee conductoare (Pt, 50nm latime) indusa prin fasciculul de electroni: structuri de test cu nanofir polimerice pentru **electronica flexibila**



Experimente in colaborare cu Universite Catolique de Louvain, DICE



LABORATORUL DE FIABILITATE – L7

Sef de laborator: Dr. Marius Bazu
marius.bazu@imt.ro



L7: Dispozitive microelectronice, Senzori, MEMS, Nanostructuri

❑ Servicii tehnologice si stiintifice

- Incercari la solicitari simple sau combinate (mecanic, termic, electric, presiune, umiditate) ▪ determinarea *ratei de defectare*

❑ Instruire, cursuri pregatite

- Asigurarea calitatii si fiabilitatii dispozitivelor cu semiconductoare
- Incercari accelerate de fiabilitate pentru MEMS
- Analiza defectarilor pentru testarea
accelerata
- Caracterizarea dispozitivelor
microelectronice si MEMS

❑ Consultanta, asistenta tehnica

- Analize de fiabilitate pentru toate tipurile de dispozitive cu semiconductoare
- Elaborarea documentatiei pentru toate tipurile de dispozitive: standarde, caiete de sarcini etc.
- Calificarea (omologarea) dispozitivelor cu semiconductoare





L7: Echipamente

- ❑ **Sistem pentru caracterizare electrica** - Keithley / 4200SCS (diverse module)
- ❑ **Echipament pentru masurari electrice in temperatura** - Temptronic / TP04300A-8C3
- ❑ **Echipament pentru caldura umeda** - Angelantoni
- ❑ **Echipament de incercari la vibratii; aplicare combinata de stimuli termici si polarizare electrica** - TIRA / TV 55240/LS
- ❑ **Echipament de incercare la ciclare termica** - Espec / TSE-11-A
- ❑ **Echipament de incercare la socuri mecanice** - Cambridge Vibration / MRAD 0707-20
- ❑ **Set de echipamente de incercari combinate la temperatura si polarizare electrica statica** - MEMMERT / 3 x UFB 400; Agilent / N6711A (N6741B,N6743B,N6746B,N6773A)
- ❑ **Echipament de incercari combinate la temperatura, umiditate, presiune si polarizare electrica** - Espec / EHS 211M - Highly Accelerated Stress Test (HAST) Chamber





**Institutul National de Cercetare - Dezvoltare pentru Microtehnologie
(IMT- Bucuresti)**

LABORATORUL DE MICROSISTEME PENTRU APLICATII BIOMEDICALE SI DE MEDIU – L2

Sef de laborator: Dr. Carmen Moldovan
carmen.moldovan@imt.ro



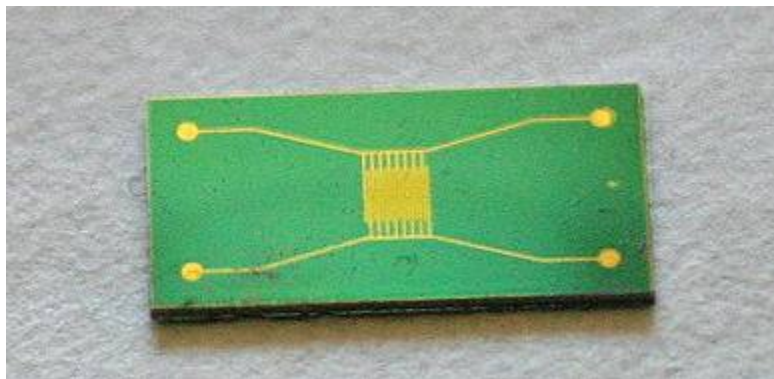
L2: Oferta de transfer tehnologic si inovare

- ☐ Senzori de pesticide;
- ☐ Senzori de gaz (CO si NO₂): electrozi cu substrate polimerice;
- ☐ Tehnologii pentru imunosenzori pentru detectia E.coli;
- ☐ Platforme microfluidice pentru integrarea senzorilor cu fluidica

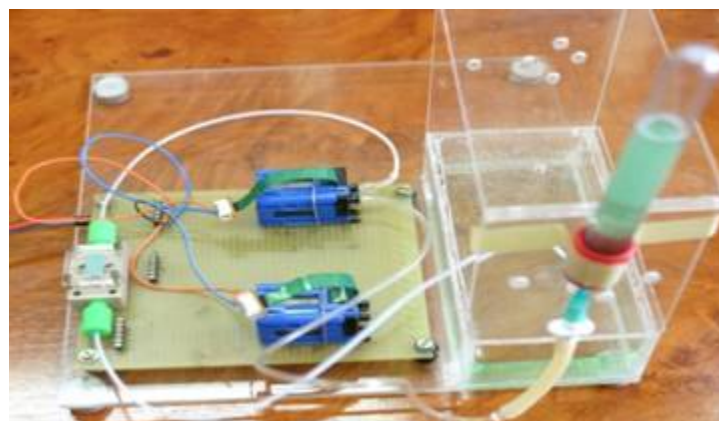


L2: Biosenzori pentru detectia pesticidelor

Senzorul prezinta doi microelectrozi interdigitali, pe substrat de siliciu, amplasati intr-un modul microfluidic.



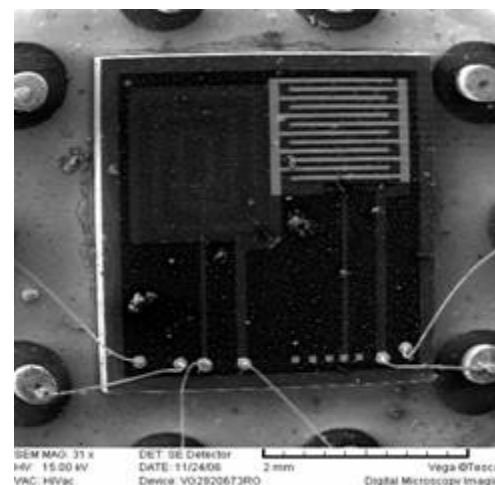
Fotografie a electrozilor de Au



Biochip din siliciu in modulul microfluidic, cu pompe si rezervor

Senzori de gaz (CO si NO₂):

Se bazeaza pe structuri de tip ISFET si electrozi interdigitali acoperiti cu straturi polimerice chemoactive.





L2: Arie tip sandwich pe suprafata de Au pentru imunodetectia de E. coli O157:H2

- ❑ Functionalizarea chimica a suprafetei de aur
- ❑ Imobilizarea anticorpilor de captare anti-E. coli O157:H7
- ❑ Imunodetectia E. coli O157:H7



Depunere utilizand Nanoplotterul

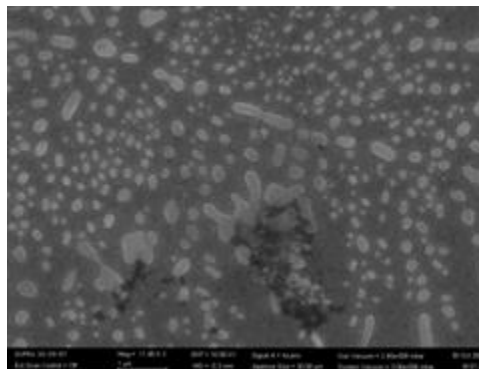
*Caracterizare utilizand Gene TacUC4
Microarray scanner - Scanarea plachetei*

Rezultate obtinute in proiectele INTEGRAM+ ("Multi-domain platforms for integrated micro-nano technology systems – Service Action"), FP6 IST IP, 2006-2008 si IMUNOSENSE (PNII, Nr. 51-083)

Analiza SEM a suprafetei bacterie-antiE.coli O157:H7

Au fost determinate concentratiile optime pentru anticorpi si antigene. Nivelul de acoperire si mentinere a unei bune morfologii a suprafetei este obtinut pentru concentratia de $c = 10^4 \text{ cfu/mL}$.

Aplicatii – Industria alimentara (alimente solide, lapte, apa), analize medicale.



Fotografie SEM a bacteriei pe suprafata de Au functionalizata, dupa reactia cu anti-E.coli O157:H7 de concentratie 10^4 cfu/mL (obtinere straturi autoasamblate - SAMs)



L2: Platforma pentru monitorizare on-line a toxicitatii

Contributia IMT:

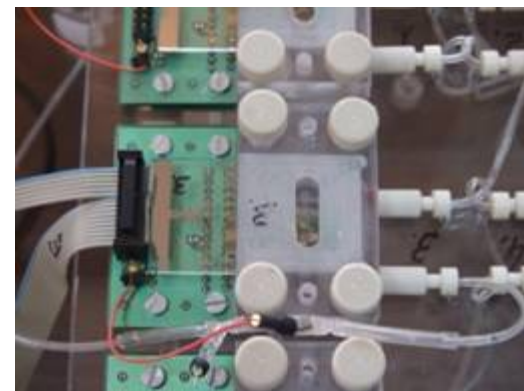
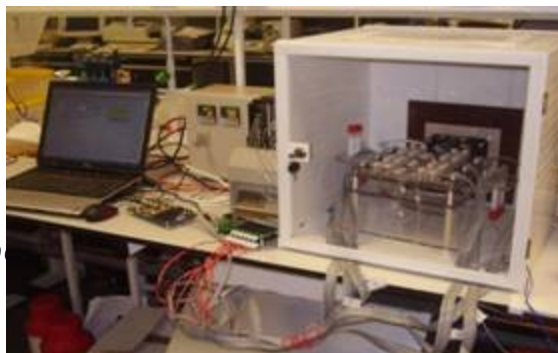
❑ Senzori pentru monitorizarea celulelor vii

Platforma de senzori – implementarea de senzori de temperatura, pH, O_2 si electrozi de referinta miniaturizati

Rezultate obtinute in proiectul TOXICHIP ("Development of a toxin screening multi-parameter on line biochip system"), FP6 IST STREP, 2006-2009

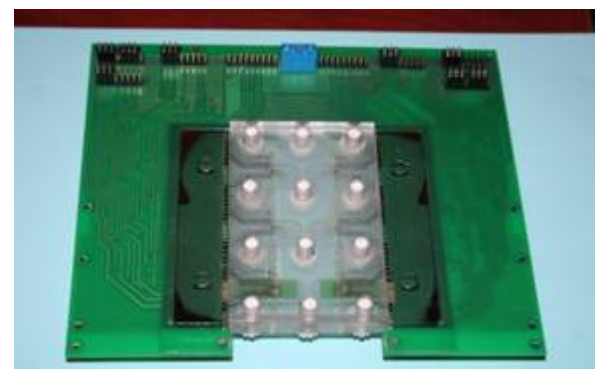
❑ Canale microfluidice

- Sistem de incalzire
- Conexiuni PCB (*printed circuit board*)
- Achizitie de date



Integrare completa – Senzori, Microfluidica, PCB

Aplicatii: Industria alimentara, industria farmaceutica, statii de tratare a apei, industria bauturilor racoritoare, analiza toxicitatii nanomaterialelor etc.

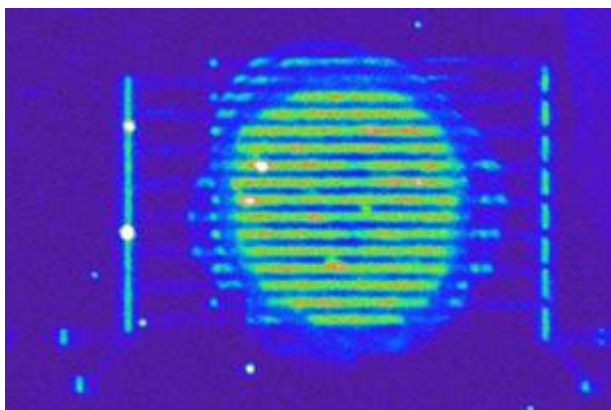




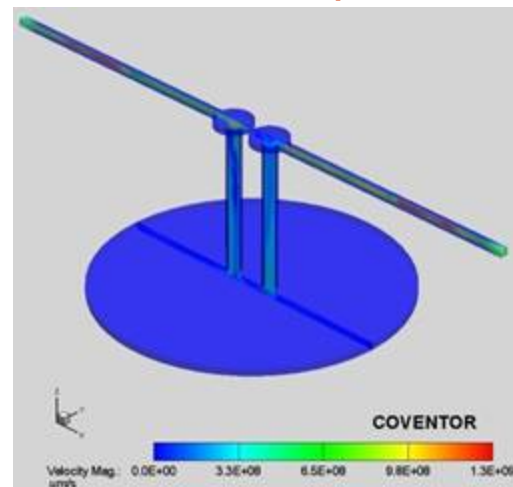
L2: Oferta de servicii

- ❑ Proiectare si simulare servicii pentru microfluidica, senzori mecanici (ex. senzori de presiune piezorezistivi);
- ❑ Tehnologii de depunere biomateriale: enzime si anticorpi (in cooperare cu DDS Diagnostic);
- ❑ Tehnologii de functionalizare a suprafetelor pentru biosenzori;
- ❑ Tehnologii pentru dezvoltarea de senzori chimici (senzori de pH, oxigen, temperatura, NO₂ si CO);
- ❑ Tehnologii pentru fabricarea de microelectrozi (pentru biosenzori si senzori chimici) si elemente de incalzire integrate pe membrane, pentru diferite subtrate
- ❑ Tehnologii pentru microprelucrarea substratelor de siliciu, sticla si polimeri

Fluorescence picture of the interdigital electrodes, with biomaterials deposited on the sensitive area and a picture of the silicon chip



Simulation picture



Modeling a fluid flow speed through a microfluidic structure for dead volumes identification



**Institutul National de Cercetare - Dezvoltare pentru Microtehnologie
(IMT- Bucuresti)**

LABORATOR DE TEHNOLOGII AMBIENTALE – L8

Sef de laborator: Dr. Ileana Cernica
ileana.cernica@imt.ro



L8: MISIUNE

- ❑ Dezvoltarea de noi tehnologii in domeniul microsystemelor: proiectare tehnologica, simulare si dezvoltare tehnologica pana la nivel de prototip
- ❑ Dezvoltarea de materiale nanostructurate (ex. Nanocompozite)
- ❑ Noi tehnici de asamblare pentru microsysteme (ex. MCM)
- ❑ Dezvoltarea sistemelor avansate de iluminare bazate pe structuri emisivie semiconductoare
- ❑ Asistenta si consultanta tehnologica(proiectare fluxuri tehnologice, porti de control, compatibilizari tehnologice)
- ❑ Caracterizare spectrometrica





L8: OFERTA DE SERVICII si APLICATII

- ❑ Noi tehnici de asamblare pentru microsisteme (ex. MCM)
- ❑ Asistenta si consultanta tehnologica(proiectare fluxuri tehnologice, porti de control, compatibilizari tehnologice)
- ❑ Caracterizare spectrometrica
- ⚙ Nanomateriale cu aplicabilitate in industria lemnului si a materialelor de constructii
 - ➡ **Silvicultura, industria prelucrarii lemnului si a materialelor de constructii**
- ⚙ Sensori pentru: monitorizarea contaminarii mediului acvatic, exploatarea resurselor petroliere, detectia tuberculozei, monitorizarea contaminarii radioactive
 - ➡ **Spitale, agentii de monitorizare a starii de sanatate a populatiei si a mediului, industria petroliera**
- ⚙ Optoelectronica: sisteme de iluminat bazate pe structuri emiseve semiconductoare
 - ➡ **Ambiental, spitale, industria automobilelor**
- ⚙ Micromatrici fotodetectoare PIN pentru telecomunicatii prin fibra optica
 - ➡ **Telecomunicatii**
- ⚙ Aarii de microsenzori piezoelectrics multifunctionali pentru monitorizarea conditiilor de stocare a cerealelor si/sau a plantelor industriale in silozuri in ferme mici
 - ➡ **Agricultura**



L8: DOTARI EXISTENTE

Echipamente pentru caracterizare:

- ❖ **Spectrometru FTIR** (Tensor 27, Bruker Optics): proiectat pentru masuratori in domeniul IR mijlociu (400 cm^{-1} - 4000 cm^{-1}), masuratorile ce se pot realiza prin transmisie sau reflexie cu o rezolutie de $0,5\text{ cm}^{-1}$. Spectrometru echipat cu sistem automat de procesare a datelor (OPUS Software).
- ❖ **Spectrometru UV-VIS (AVANTES)**: alcatuit din trei spectrometre acoperind domeniul spectral 200-1100nm. Masuratorile pot fi de absorbtie, transmisie, reflexie si iradiere cu o rezolutia spectrala este de 0,5 nm. Spectrometru echipat cu sistem automat de procesare a datelor (AvaSoft).

❖ RTP (in curs de achizitionare)

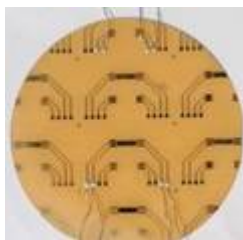
Este o alternativa a cuptoarelor standard. Principalele avantaje sunt timp de annealing mic (de la o secunda la 3 minute) si controlul precis a profilului de annealing. Sunt folosite urmatoare gaze : argon, azot, oxigen si amoniac. *Aplicatii*: RTA (Tratament Termic Rapid), RTO (Oxidare termica Rapida), difuzie, annealing compusi semiconductori, nitridatizare, silicidizare, recristalizare si densificare.(Annealsys-Franta)

Echipamente pentru asamblare:

- ❖ **Masina trasare plachete siliciu** de 2, 3 si 4 toli, efectueaza trasarea plachetelor de siliciu in cipuri, cu discuri diamantate cu grosimea de 25 si $40\mu\text{m}$, pana la o adancime maxima de $600\mu\text{m}$. (ЭМ225-Rusia)
- ❖ **Masina sudura ultrasunete conexiuni fir aluminiu**: executa operatii de sudura firului de aluminiu de $\phi=25\mu\text{m}$ pe padurile cipurilor, la temperatura mediului ambiant, la o frecventa de 50-60kHz. (US-DRAHTBONDER MDB-11- Germ)
- ❖ **Masina sudura termosonica fir aur**: executa operatii de sudura firului de aur de $\phi=25-35\mu\text{m}$ pe padurile cipurilor, la temperatura de $150-250^{\circ}\text{C}$, la o frecventa de 50-60kHz. (ASM - SUA)



L8: REALIZARI LABORATOR



Senzori piezoelectrice
configurati pe placheta de
langasit / tantalat

CEXX / MICROBALERT



LED si matrice cu emisie de
lumina alba

MATNANTECH /
MATRIX -LA



Micromatrice PIN pentru
comunicatii cu fibre
optice

RELANSIN / FOTOPIN



Structura "ciment-lemn"
acoperita cu matrice
polimerica cu
nanomateriale

CEEX / NANOAMBIENT



Placa "lemn-polimer"

PNCDI II /
NANOPROTECT



Compozit lignocelulozic
acoperit cu lac
hidrodiluabil cu
nanoparticule

MATNANTECH /

Accesul IMM-urilor inovative la tehnologie
si la surse de finantare



L8: Proiecte in desfasurare si de viitor

Cat se poate de apropiat !

- ❑ *Aplicatii ale materialelor nanostructurate in culturi de sera si solarii **FLORES***
- ❑ *Dezvoltarea de micro/nanosisteme predictiv-reactive pentru sigurantarea infrastructurii de transport **VIA SAPIENS***
- ❑ *Sisteme de microsenzori cu aplicatii in monitorizarea forajului submarin si industria forestiera **SALVE SILVAE***

- ❑ *Sisteme semiconductoare inovative de iluminare*
- ❑ *Tehnologii de procesare a microsenzorilor pe substrate piezoelectrice avansate (monocristaline si filme subtiri)*
- ❑ *Arii de micro/nanosenzori de prag pentru detectia in timp real a contaminarii mediului acvatic cu agenti chimici*

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Va multumim!

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