



**Retea de servicii științifice de structurare
și caracterizare
la scara nanometrică, cu aplicații în dezvoltarea
de tehnologii convergente**

NANOSCALE-CONV

Coordonator IMT - București

**Dr. Raluca Muller
Fiz. Adrian Dinescu**



| | |
|------------|---|
| P1 | IMT Bucuresti- coordonator |
| P2 | Institutul de Chimie Macromoleculara "Petru Poni" |
| P3 | INCD pentru Fizica Lasarilor, Plasmei si a Radiatiei |
| P4 | INCD pentru Fizica Materialelor |
| P5 | INCD-ICPE-CA |
| P6 | Universitatea Ovidus - Constanta |
| P7 | Universitatea "Politehnica"- Buc. |
| P8 | INCD pentru Tehnologii Izotopice si Moleculare- Cluj |
| P9 | SCN -Pitesti |
| P10 | INCD pentru metale neferoase si rare- IMNR |
| P11 | Institutul de Chimie –Timisoara- al Academiei Romane |

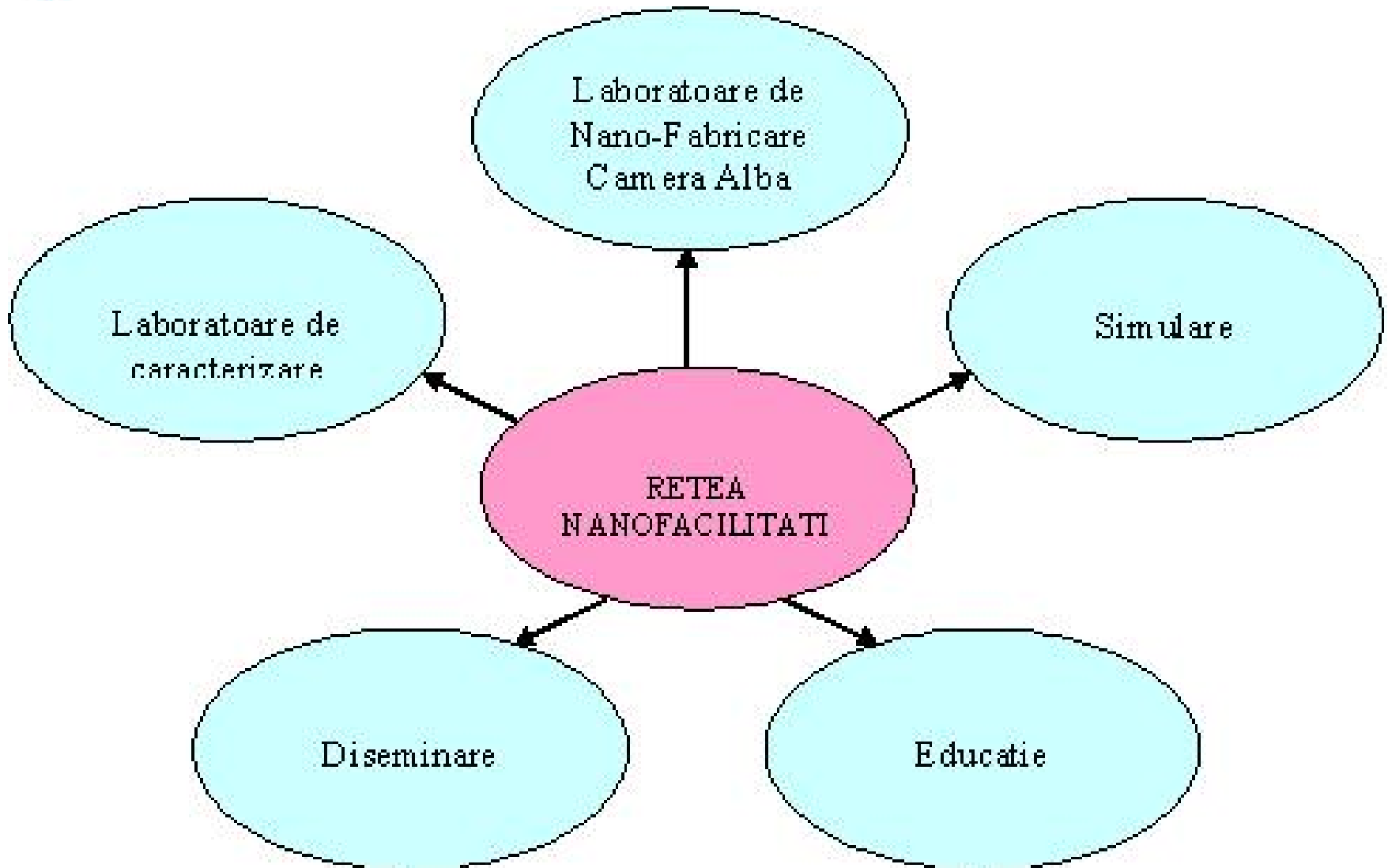


Principalul obiectiv:

- a realiza o masa critica la nivel national,
- a uni excelenta
- a reduce fragmentarea,
- a realiza o integrare pe termen lung in domeniul structurarii si caracterizarii la scara nanometrica

Principalele activitati:

- ▶ Partenerii din consortiu vor utiliza in comun *infrastructura* existenta si cea care va fi achizitionata in viitor, **echipamentele de caracterizare si fabricatie**, adesea deosebit de costisitoare, *competentele stiintifice complementare*, realizand o retea de servicii stiintifice de structurare si caracterizare la scara nanometrica, cu aplicatii in **dezvoltarea de tehnologii convergente**.
- ▶ Se vor realiza cercetari comune pentru obtinerea unor **demonstratoare de nanodispozitive** care sa corespunda cerintelor europene





Principalele obiective:

- ▶ **utilizarea in comun a echipamentelor costisitoare; cercetari noi, inovative;**
- ▶ **realizarea de laboratoare virtuale, conectate prin internet, la nivel national;**
- ▶ **acces pentru studentii-master si doctoranti;**
- ▶ **invatare prin cercetare;**
- ▶ **accesul companiilor industriale la acest echipament si cunostiinte noi;**
- ▶ **dezvoltare de tehnici si idei noi;**
- ▶ **realizare demonstratoare de nanodispozitive;**
- ▶ **cresterea capacitatii Romaniei de a asigura parteneri performanti in programele FP7 pregatirea si trimitera unor proiecte care sa se adreseze prioritailor din programul EU -FP7**
- ▶ **dezvoltare de servicii si cercetari complexe care sa corespunda cerintelor europene;**



Activitati

- ▶ **stabilirea modului de lucru si accesului la echipamentele partenerilor**
- ▶ **realizarea unor puncte de lucru**
- ▶ **utilizarea in comun a facilitatilor, integrarea activitatilor de cercetare si caracterizare ale partenerilor**
- ▶ **inventarierea echipamentelor de caracterizare / resurselor existente**
- ▶ **achizitionarea unui echipament pentru fabricarea si cercetare la scara nanometrica, la care vor avea acces toti partnerii din retea care va fi amplasat in camera curat-a 2005**
- ▶ **realizarea unei pagini de web, prin care toti partenerii implicati sa cunoasca dotarile care vor putea fi utilizate in comun (realizare unor baze de date) - 2005**
- ▶ **realizarea unor activitati comune de cercetare**
- ▶ **elaborarea unui plan complex de utilizare a metodelor de caracterizare**
- ▶ **elaborarea si realizarea unui program de educare**
- ▶ **diseminarea rezultatelor obtinute**



2005 -Etapa I

Achizitionarea unui echipament de nanolitografie pentru cercetare si fabricare nanostructuri la care vor avea acces toti partnerii din retea

FAZA I.1 Achizitie de Echipament de nanolitografie

- ▶ **studiu privind structurarea la scara nanometrica si a instalatiilor de obtinere ale nanomaterialelor si nanostructurilor**
- ▶ **stabilirea echipamentului care va fi achizitionat; studiul metodelor nanolitografice**
- ▶ **amenajarea spatiului de lucru din camera alba IMT/in Parc Tehnologic.**
- ▶ **stabilirea ofertei initiale de servicii comune**
- ▶ **initiere pagina de web**



2006 -Etapa II- 30 Mai 2006

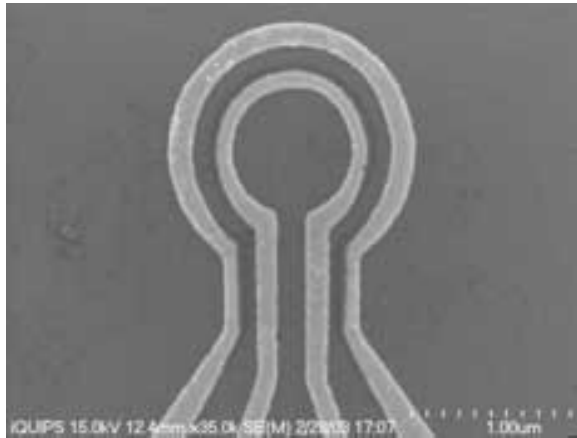
Inventarierea resurselor consortiuului// Stabilirea ofertei de servicii comune

FAZA II.1 Inventarierea echipamentelor / resurselor existente si realizarea unei pagini de web, prin care toti partenerii implicati sa cunoasca dotarile care vor putea fi utilizate in comun

- ▶ realizare unor baze de date
- ▶ stabilirea unei oferte de servicii complexe
- ▶ realizarea unor puncte de lucru pentru P2 si P3 si camera alba a P1

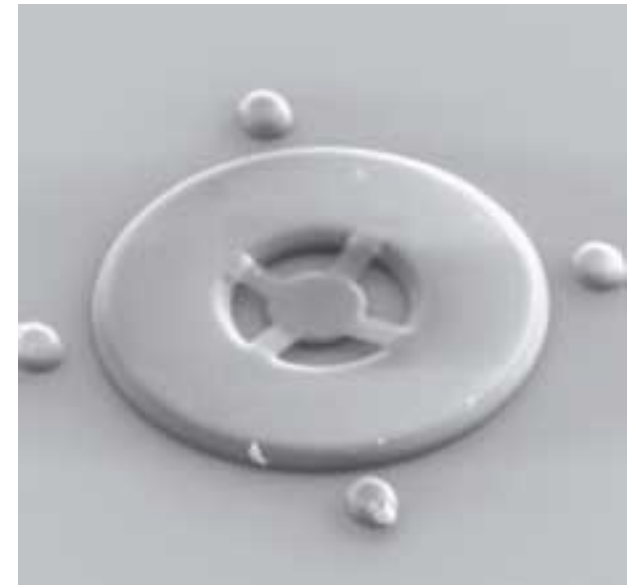


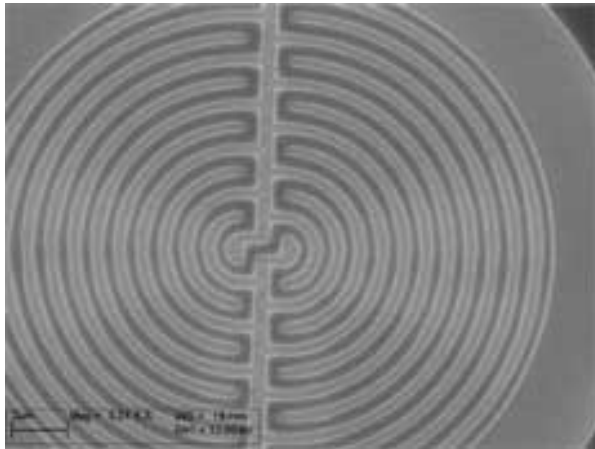
Instalatie de nanolitografie cu fascicul de electroni EBL



Coupled nano electromagnet

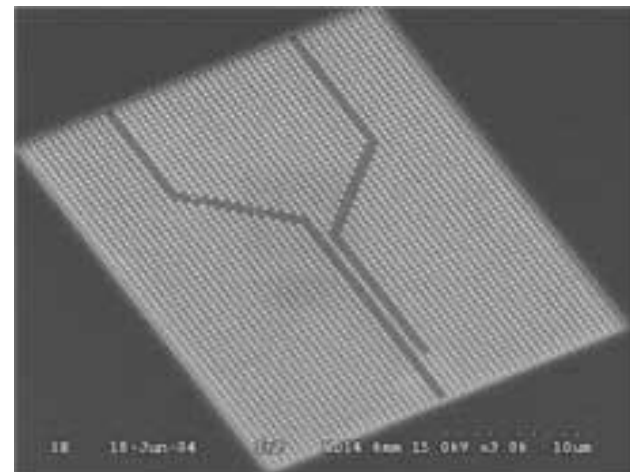
Nano fluidic system - accelerometer





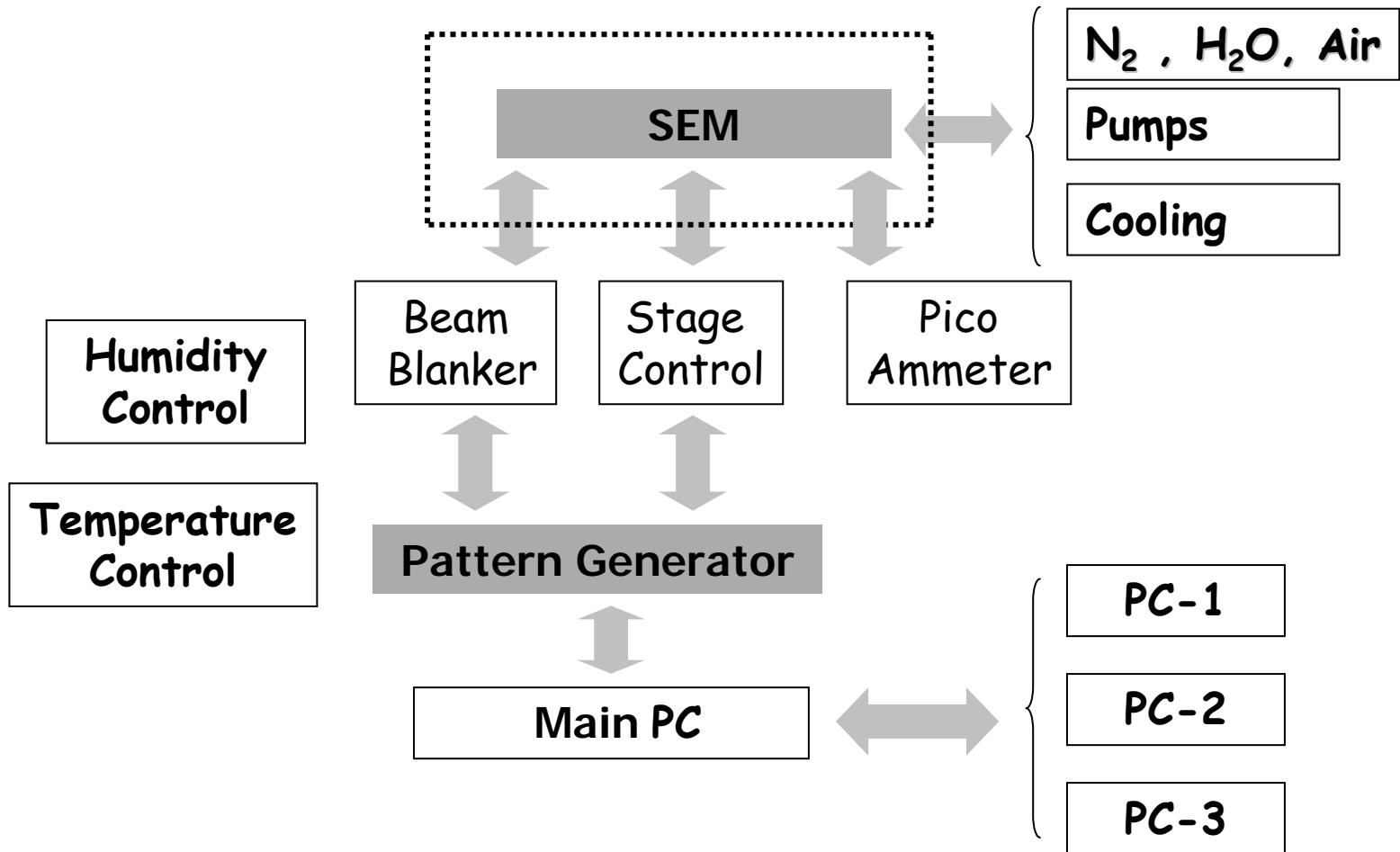
Prototyping of Microwave antennas

Photonic crystal structure used to fabricate optical waveguide devices





System Overview

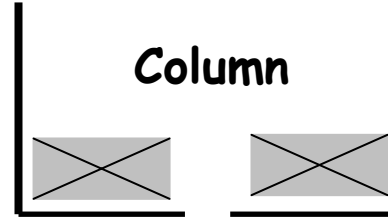




Translation Accuracies

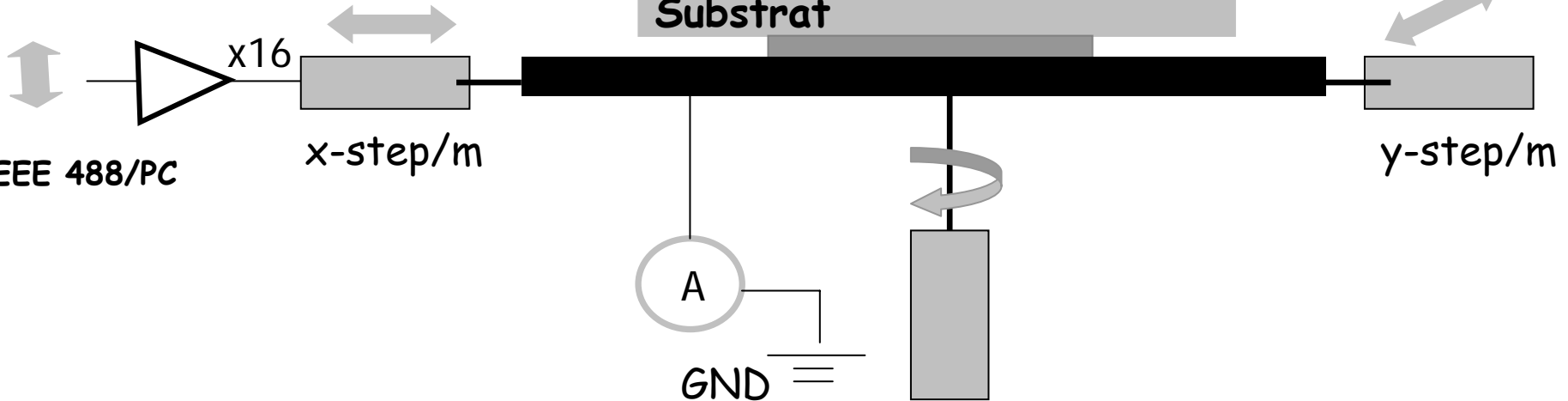
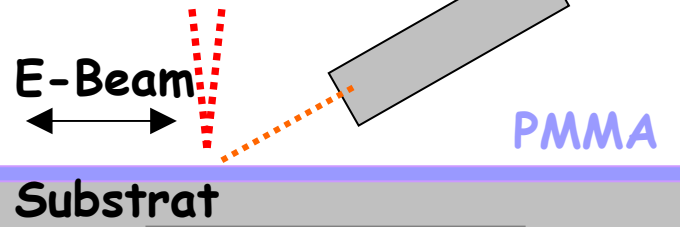
- (i) Step Motor ~ 2 μm
- (ii) Nanostage ~ 100 nm
- (iii) LASER stage ~ 10 nm

EBL



Detectors, SE, BSE, EDX

Specimen Chamber





TESCAN

VEGA 5136 LM





VEGA TS 5136LM - Technical Specifications

Resolution

| | |
|---|-----------------|
| In high vacuum mode (SE) | 3 nm at 30 kV |
| In low, medium vacuum mode (BSE, LVSTD) | 3.5 nm at 30 kV |

Working vacuum

| | |
|--------------------|------------------------------------|
| High vacuum mode | $< 1 \times 10^{-2}$ Pa |
| Medium vacuum mode | 3 – 150 Pa |
| Low vacuum mode | 3 – 500 Pa (optionally 2000 Pa) |

Electron optics working modes

| | |
|---------------|--|
| High Vacuum | Resolution, Depth, Field, Fish-eye, Rocking beam |
| Medium Vacuum | Resolution, Depth, Field, Fish-eye |
| Low Vacuum | Resolution |

Magnification

| | |
|-------------------------------------|-------------------|
| At 30kV in Resolution Mode | 13x to 1 000 000x |
| Min. magnification in Fish-eye mode | about 4x |

Accelerating voltage

200 V to 30 kV

Electron gun

Tungsten heated cathode

Probe current

1 pA to 2 μ A

Scanning

| | |
|-----------------|--|
| Scanning speed: | From 200 ns to 10 ms per pixel adjustable in steps or continuously |
| Focus window: | Shape, size and position continuously adjustable |
| | Dynamic Focus, Point & Line Scan |

Image size

Up to 4 096 x 4 096 pixels, adjustable separately for live image (in 4 steps) and for stored images (9 steps), selectable square or 4:3 or 2:1 rectangle

Microscope control

All microscope functions are controlled by means of PC via the VegaTC program using Windows™ platforms

Remote control

Via TCP/IP

Automatic procedures

Vacuum control, Filament heating, Gun Alignment, Centering of Resolution mode, Compensation for kV, Probe Current optimized for Spot Size, Spot Size optimized for Magnification, Scanning Speed, Contrast & Brightness, Focus & Stigmator, Look up Table

Pumping after specimen exchange

typically < 3 minutes



VEGA TS 5136LM – Standards

| | |
|---|---|
| Type of chamber = LM | |
| Large chamber, motorized semi-compucentric stage | |
| Chamber and column suspension | |
| pneumatic | |
| Chamber LM | |
| Internal diameter | ∅230 mm |
| Door width | 148 mm |
| Number of ports | 11 |
| Specimen stage | |
| Type | semi-compucentric X= 80 mm - motorized Y= 60 mm - motorized Z= 47 mm - motorized |
| Movements | Rot.: 360° continuous - motorized Tilt: manual, -75° to +50° from WD 15mm and for eucentric height of the specimen |
| Maximum specimen height: 60mm | |

- SE detector
- Retractable BSE detector
- Probe current measurement
- Touch alarm
- Chamber view camera

- Software
 - Measurement
 - Image Operations
 - Image Processing
 - 3D Scanning
 - Hardness
 - Multi Image Calibrator
 - Object Area
 - Print magnification
 - Switch-Off Timer
 - Tolerance

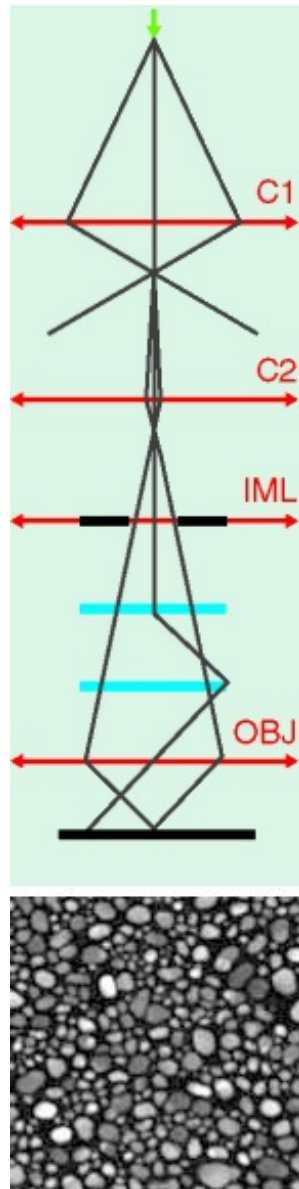
Option:

- LVSTD
- TE detector
- EBIC
- EDX*
- WDX*
- EBSD*
- Cooling stage with Peltier Couple

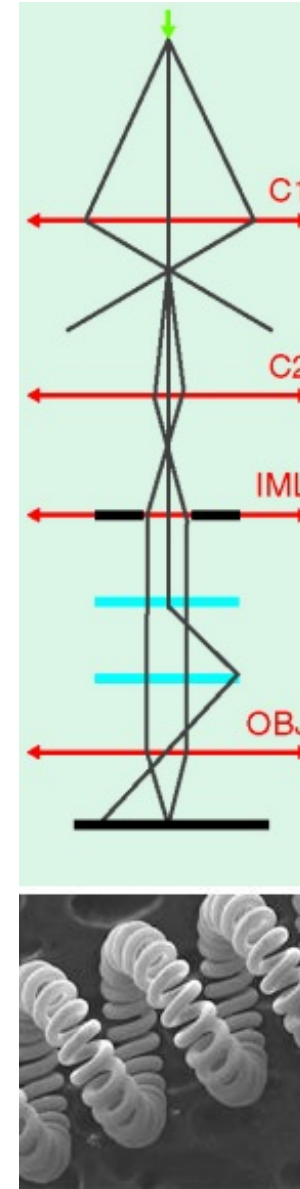
- Software:
 - Morphology
 - Particle Analysis
 - Image Observer
 - Image Snapper
 - MouseLink



SEM Resolution Mode

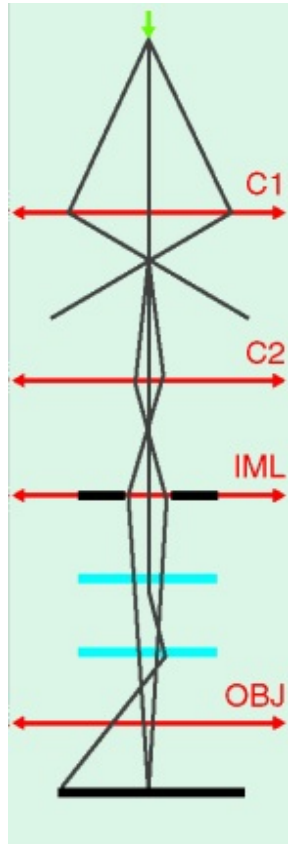


SEM Depth Mode

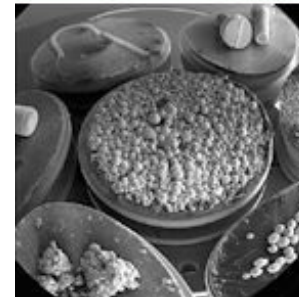
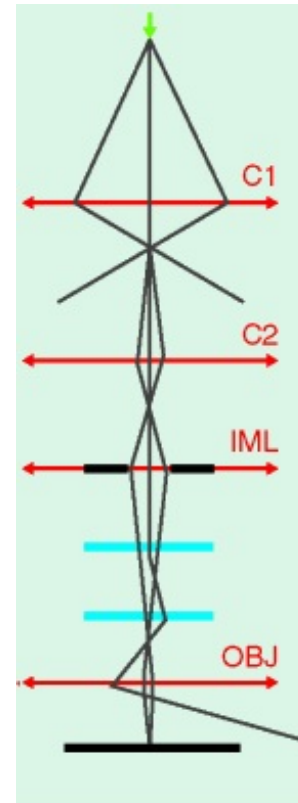




SEM Field Mode



SEM Fish-eye Mode





ELPHY Plus - Advanced SEM/FIB System for Nanolithography





ELPHY Plus Hardware

- 6 MHz high-speed pattern generation hardware (19" DSP Unit decoupled from PC)
- Fast, noise-reduced, deglitched and high performance 16 bit DAC vector scan beam deflection
- 16 bit DAC vector scan beam deflection
- 2 ns writing speed resolution
- TTL and 100 V blanking signal drivers
12 bit AD channel for reading detector signal (image acquisition)
TTL signal for FIB/SEM external beam control request
- 3 additional DAC per channel for scaling, rotation / orthogonality and shift (for hardware alignment and hardware calibration)
- Decoupling from PC electronics and thermocontrol for main and calibration DACs



Concluzii

Cele mai importante **beneficii** ale proiectului vor fi:

- utilizarea in comun a echipamentelor costisitoare;
- cercetari noi, inovative
- realizarea de laboratoare virtuale, conectate prin internet, la nivel national,
- acces pentru studentii-master si doctoranzi
- invatare prin cercetare
- achizitia in comun a unui echipament care sa reprezinte “state of the art” in domeniu
- accesul companiilor industriale la acest echipament si cunostiinte noi
- proiectul va fi deschis pentru dezvoltare de tehnici si idei noi
- realizare demonstratoare de nanodispozitive, care sa contribuie la rezolvarea unor probleme cheie din domeniile proritare in programul EU FP7
- dezvoltare de servicii si cercetari complexe care sa corespunda cerintelor europene