



Micro and nano fabrication services:

- Oxidation and diffusion
- Thin film deposition: CVD, PVD, MBE, ALD
- Patterning technologies: photo and e-beam lithography, NIL; dry etching: RIE, DRIE
- Wafer bonding, Chip dicing, wire bonding

Characterization services:

- Optical and scanning electron microscopy
- Scanning probe microscopy
- Nanoindentation
- Ellipsometry
- Spectroscopic methods: Raman, FTIR, UV-ViS, XRD
- Electrical measurements – from DC up to 110GHz

Centrotherm E1200 H (Centrotherm Photovoltaics, Germany) Horizontal furnace system for R&D and small-scale production



Four independent quartz tubes dedicated to following processes:

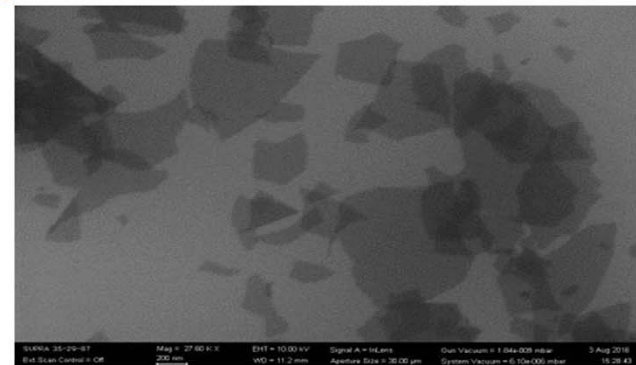
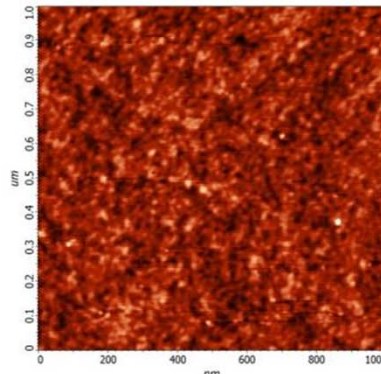
- Boron diffusion
- Phosphorous diffusion
- Annealing
- Wet and dry oxidation for thermal silicon dioxide (SiO_2)

Features

- Running independent process or in parallel at temperatures up to 1200 °C
- High temperature accuracy on 3 heating zones with maximum deviation of 0.1°C
- Full registration & monitoring data for all processes & parameters
- Integrated lift for automated boat handling
- Loading up to 35 silicon wafers/process on boat - 4 inch size

Experimental results for thermal SiO_2

- ✓ Variation of thickness uniformity less than 0.5% on silicon wafer
- ✓ High reproducibility on batch to batch and wafer to wafer processes
- ✓ Processes ready 90 & 300 nm SiO_2 substrate for graphene transfer
- ✓ RMS roughness less than 0.3 nm

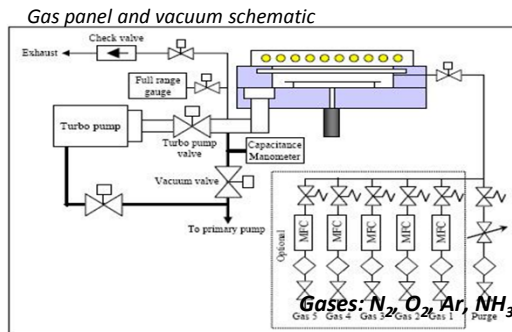




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Instrumente Structurale
2014-2020

RTP- Rapid Thermal Processing system for Silicon, Compound Semiconductors, Photonics and MEMS processes



APPLICATIONS

- Rapid Thermal Oxidation (RTO)
- Rapid Thermal Nitridation (RTN)
- Crystallization and Densification
- Compound semiconductor annealing
- Diffusion
- Silicidation
- Glass reflow
- Sintering (contact alloying)

SUBSTRATES

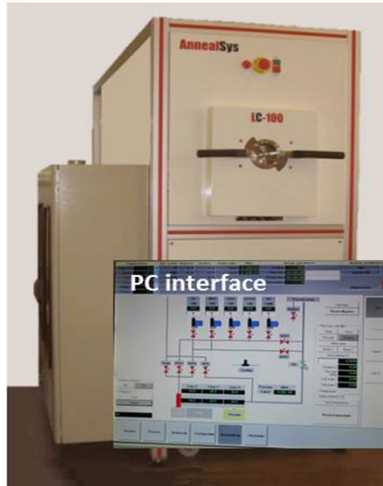
- Silicon wafers
- Compound semiconductor wafers
- Glass substrates
- SiC and graphite wafers

SPECIFICATIONS

- 3-inch and 4-inch wafer capability
- High reliability assures low cost of ownership.
- Stainless steel cold wall chamber technology
- High process reproducibility
- Ultra clean and contamination-free environment.
- High cooling rates and low memory effect
- High vacuum version (10^{-6} mbar) is available for cleanest process conditions
- Pyrometer and thermocouple temperature measurement are standard features
- Fast digital PID temperature controller provides high and stable temperature accuracy ($\pm 1^\circ C$) over the temperature range
- Edge pyrometer viewport insures enhanced temperature control of the susceptor for compound semiconductors and small samples.

ANNEALSYS LC100 (Annealsys, France)

Low pressure chemical vapor deposition tubular furnace (LPCVD)



Dedicated to following processes:

- Low stress silicon nitride (Si₃N₄)
- Polysilicon (poly-Si)
- Annealing
- Low thermal oxide (LTO)

Features

- ❑ Up to 50 wafers per process (3 or 4 inch)
- ❑ Up to 6 process gas lines with mass flow controllers
- ❑ High degree of reproducibility and relatively short deposition time
- ❑ Auto-tuning capability controller and continuous parameter adaptation

Results

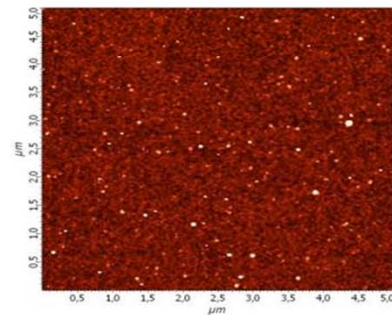
- ✓ Variation of thickness uniformity less than 2%
- ✓ High reproducibility on batch to batch and wafer to wafer processes



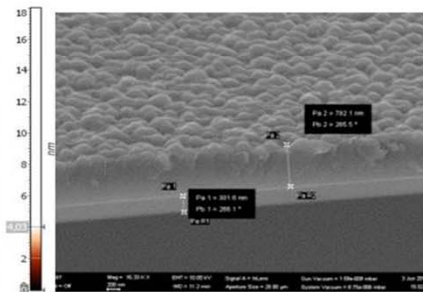
4 inch silicon nitride



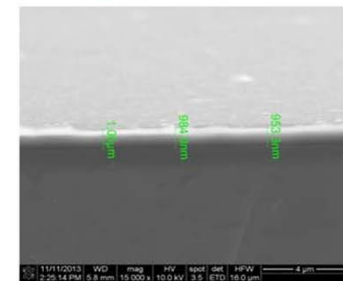
4 inch polysilicon



*Silicon nitride, AFM topography
(thickness 200 nm, RMS=0.4 nm,
resistivity 10²¹ ohm.cm)*



*Polysilicon on SiO₂/Si substrate
SEM image, deposited at 610°C
thickness 780nm*



*1 μm LTO on Si substrate
Deposited at 380°C, silane
and oxygen precursors*



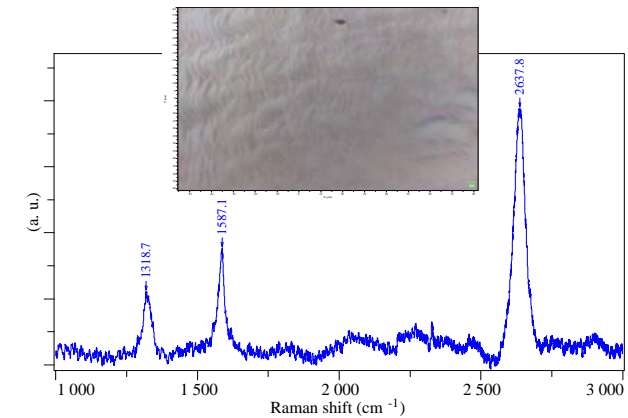
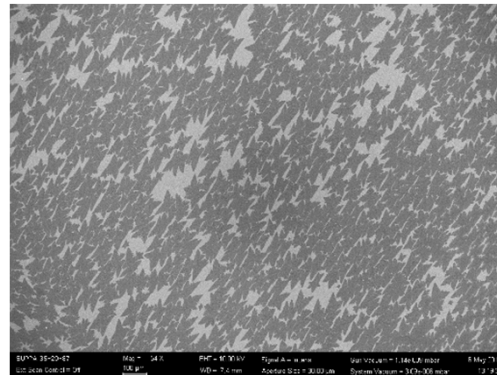
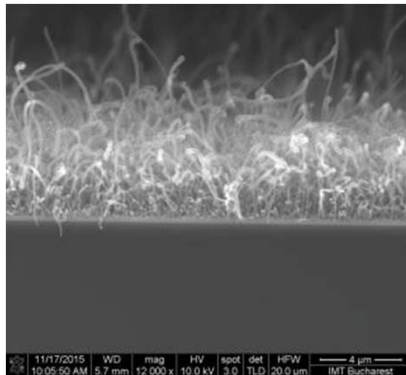
Plasma Enhanced Chemical Vapour Deposition (PECVD)

Oxford Instruments

Plasmalab System 100

Nanofab700

- Controllable growth of nanotubes and nanowires with flexible temperature up to 700°C
- Compatible with a wide range of process gases including oxygen
- Plasma pre-treatment of the catalyst and chamber cleaning capability
- PECVD – Standard and high temperature deposition



Proiect cofinanțat din Fondul European de Dezvoltare Regională
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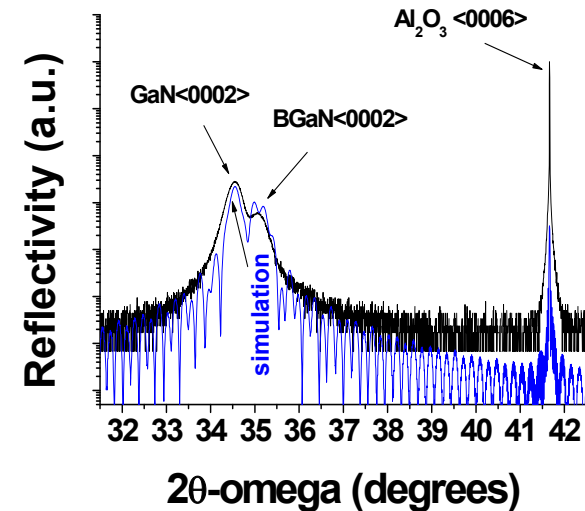
MBE – Molecular Beam Epitaxy



GROWTH CHAMBER (2)

- 3" wafer growth chamber
- 12 sources ports
- High speed electrically driven cell shutters
- High temperature, high uniformity substrate heater – up to 1800°C
- Remote control of equipment
- All modern in-situ monitoring capabilities
- Customized bottom flange

IDEAL FOR III-V / II-VI / GaN / GRAPHENE / OXIDES...APPLICATIONS



X-ray diffraction curve (black line) of the B_{0.07}GaN/GaN/sapphire heterostructure together with a simulation of the grown structure assuming 7.7% of B into B_{0.07}GaN, 21 nm B_{0.07}GaN and 28 nm GaN-on-sapphire.



OpAL™ Systems for thermal and remote plasma ALD

Oxford Instruments



Applications

- High-k gate oxides
- Storage capacitor dielectrics
- High aspect ratio diffusion barriers for Cu interconnects
- Pinhole-free passivation layers for OLEDs and polymers
- Highly conformal coatings for microfluidic and MEMS applications
- Coating of nanoporous structures
- Fuel cells

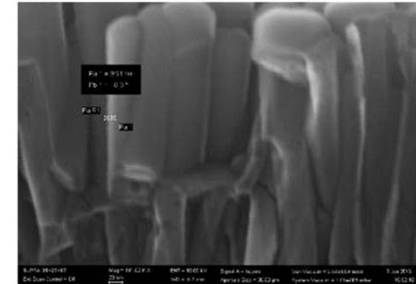
Al₂O₃

- Precursors:
 - TMA, H₂O
- Applications
 - Medium k (~9) dielectric
 - Wear resistant coating of MEMS structures
 - Passivation layer
 - good moisture barrier – e.g. OLED passivation



HfO₂

- Precursors:
 - TMAH, H₂O
- Applications
 - High k (~20) dielectric
 - Gate dielectric



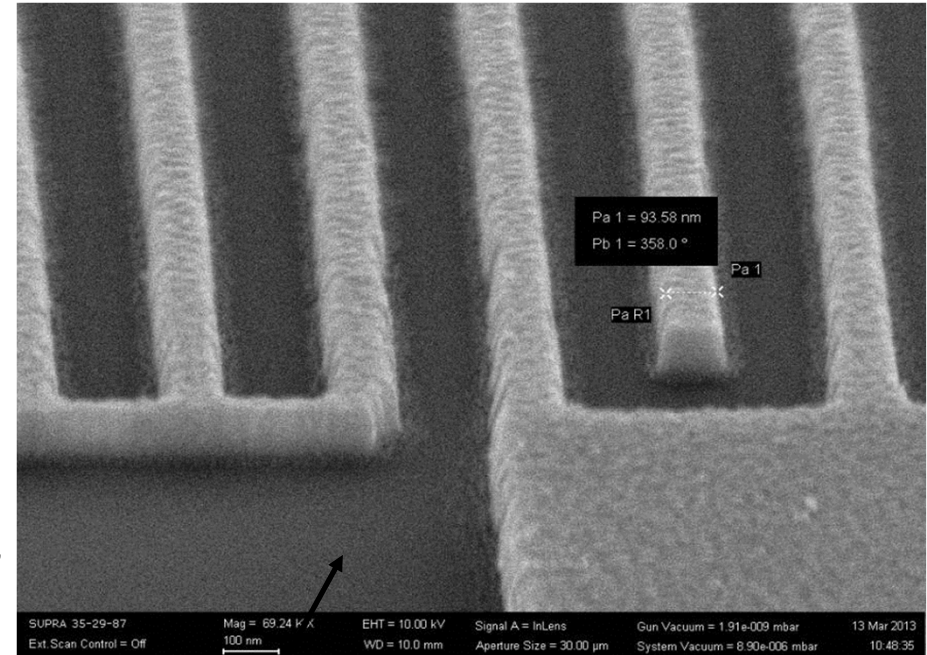
SEM cross section images for 10 nm Al₂O₃ deposition by ALD on ZnO nanowires

Process Library

	Al	Hf	Ta	Ti	Zn
Oxides	Al ₂ O ₃	HfO ₂	Ta ₂ O ₅	TiO ₂	ZnO
Multi-component oxides	Al ₂ O ₃ : Zn	HfAlO	TiTaO _x		ZnO:Al



Temescal FC 2000 is a clean-room compatible, bell-jar shaped, load locked PVD system equipped with both e-beam and thermal evaporation sources



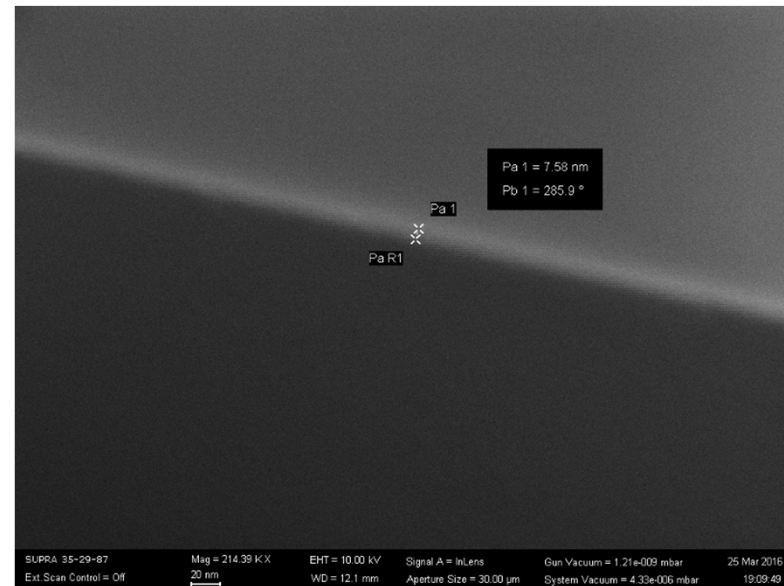
Interdigitated electrodes with <100nm width, fabricated by e-beam lithography and highly directional metal evaporation of 10nm Cr and 100nm Au.



Magnetron Sputtering Deposition – Plasmalab System400



- Single chamber with up to 4 × 200 mm targets
- Deposit from 2 nm to 20 μm films
- Pulsed DC, DC or RF deposition
- Oscillation capability for thin, uniform films
- High vacuum for quality deposition
- Rotating shutter for target & wafer preparation
- RF bias for substrate cleaning
- Up to 4 gas channels for reactive sputtering



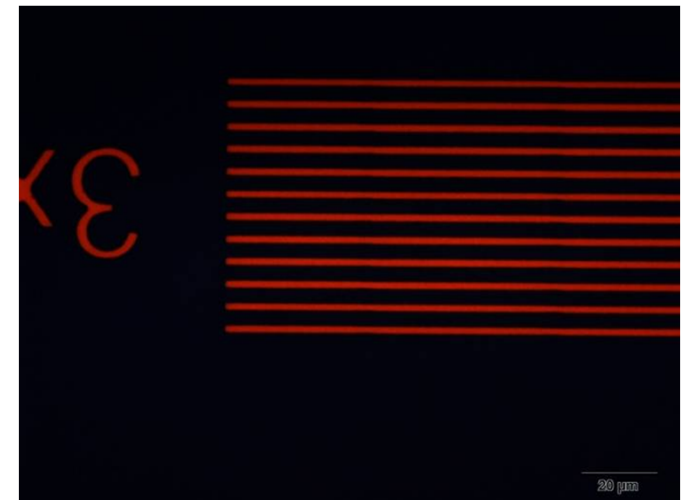
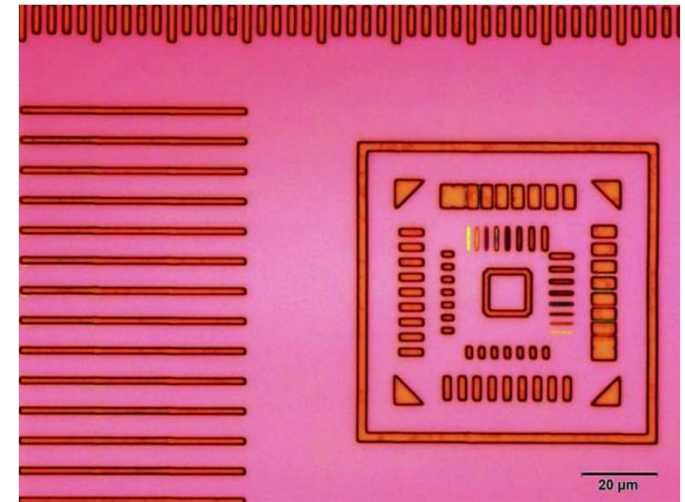


Masks Shop -IMT Bucharest-



DWL 66fs can be used for laser inscription mask, using a DIODE laser with wavelength 405-nm, or directly to the wafers up to 6" realizing a minimal window of 0.6 microns, with the 2 mm writehead. The equipment works in 3D (32 layers).

Proiect cofinanțat din Fondul European de Dezvoltare Regională
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MA6 Mask Aligner with UV-NIL upgrade



MA 6

Mask and Wafer/Substrate

Substrate Size: 3" and 4"
Mask Size: 4" and 5"

Exposure Modes

Contact: soft, hard, low vacuum,
vacuum
Flood Exposures

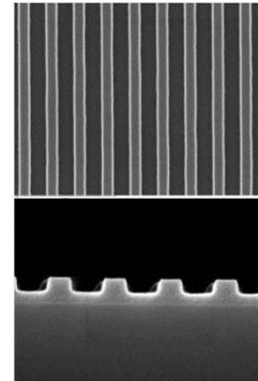
Exposure Optics

Resolution down to 0.8 μm
Wavelength range
UV400 350 – 450 nm
UV250 240 – 260 nm
Intensity Uniformity +_5%

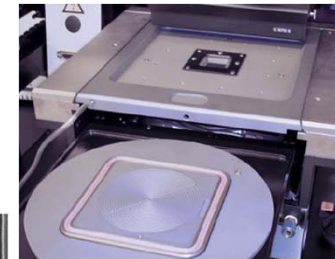
Alignment Methods

Top Side Alignment (TSA);
Bottom Side Alignment (BSA)
Image Storage Alignment System
Accuracy:

TSA down to 0.5 μm
BSA down to 1 μm



Line width: 114 nm
Residual: 58 nm



Template holder and
chuck for NIL allow
printing resolutions
in the nanometer range



Quartz stamp



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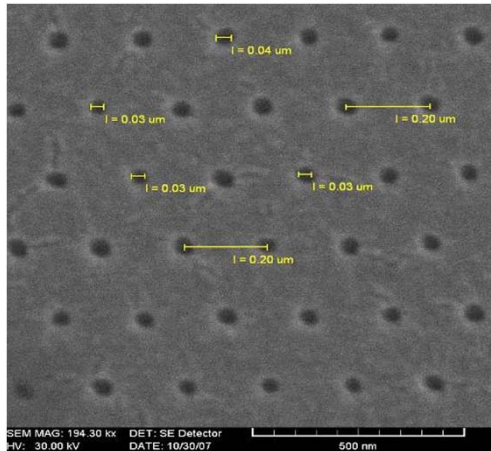
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Electron Beam Lithography equipment at IMT Bucharest



**First EBL equipment in IMT - Tescan Vega
LMU II and Raith Elphy Plus – installation 2006**

**Smallest beam diameter : 5nm @
3pA beam current and 30kV**

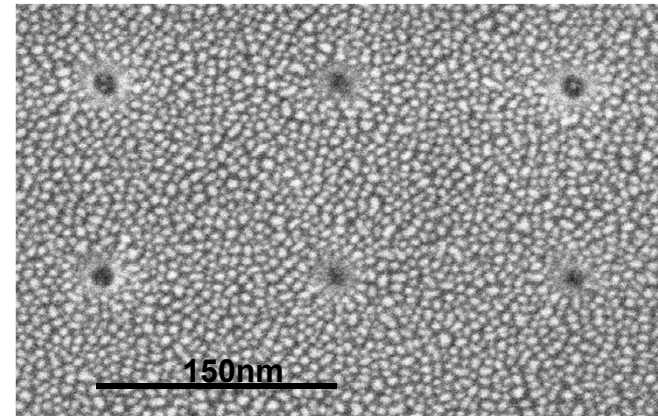


**30nm diameter holes in PMMA
950k**



Raith e-Line – installation 2008

Smallest beam diameter: 1.5nm @ 200pA



~ 10nm diameter holes in PMMA 950k

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IMT
București



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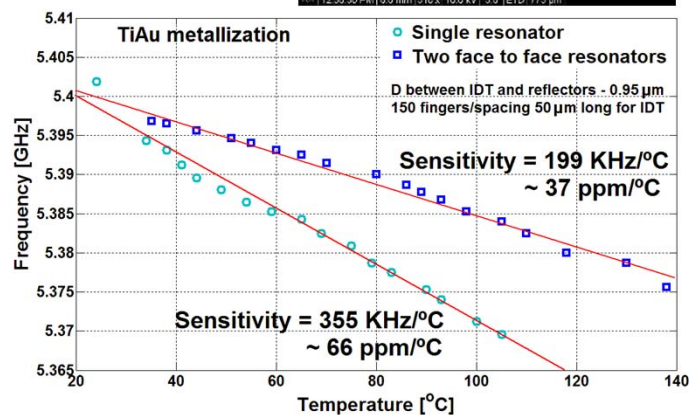
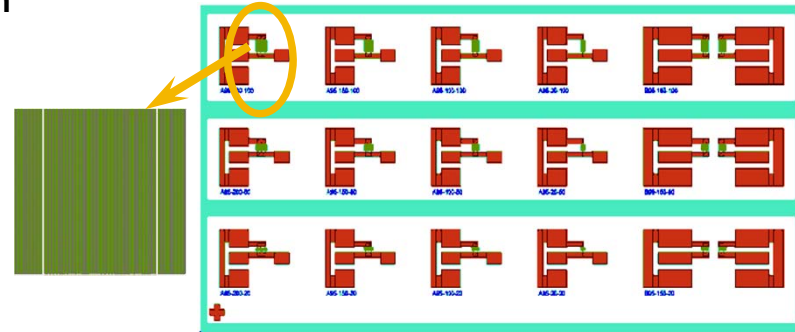
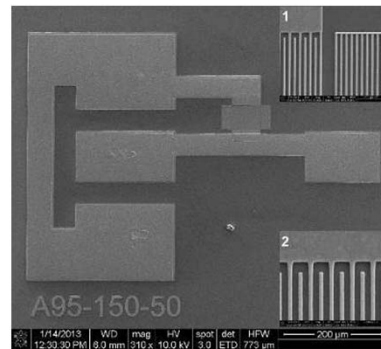


GUVERNUL ROMÂNIEI

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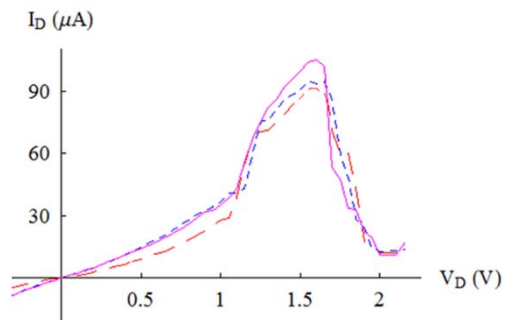
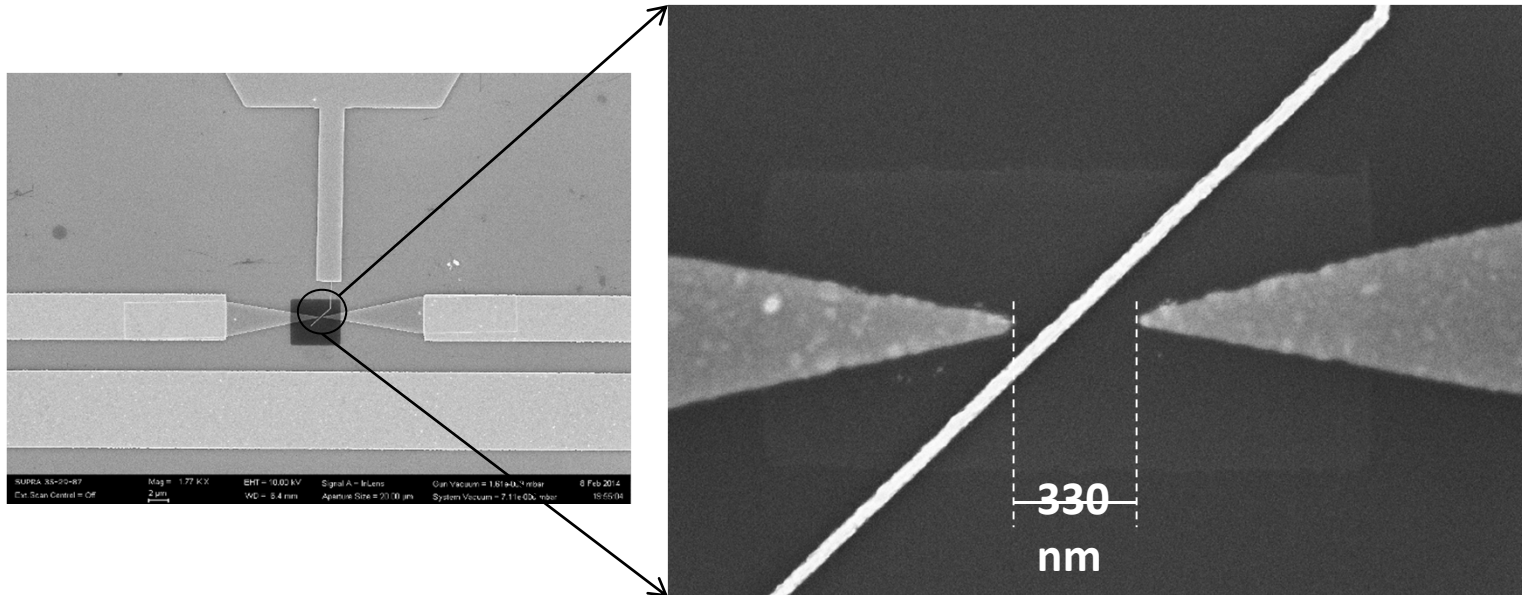
Temperature sensors based on SAW devices

- SAW resonators fabricated, based on new mask design in order to minimize the return loss at resonance and maximize Q
- Both one-port and diport connection pads are provided
- SAW structures having the IDT with 200 nm wide finger and interdigit spacing;
- Finger heights: 100 μm ; 50 μm ; 20 μm ;
- 200 fingers; 150 fingers; 100 fingers; 20 fingers and 50 reflectors;
- Distance between IDT and reflectors: 0.95 μm



The temperature dependence of the resonance frequency obtained for the SAW single and face to face resonators (RUN 3 “on wafer” hot plate measurements)

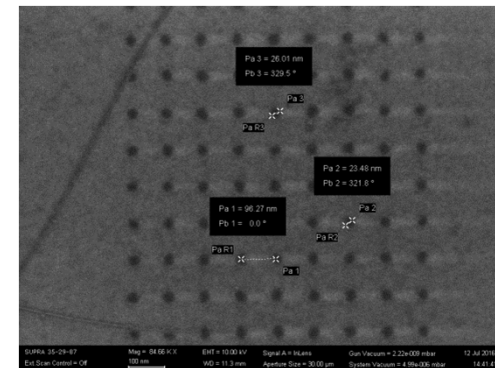
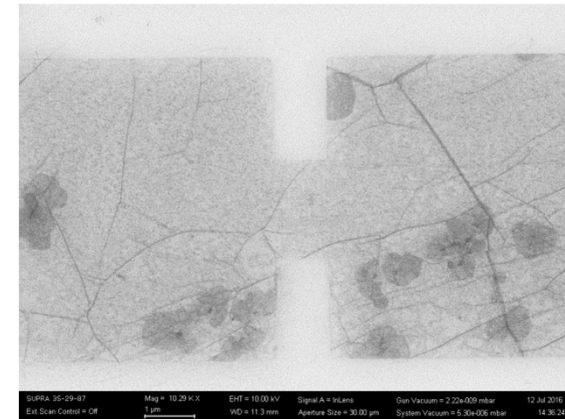
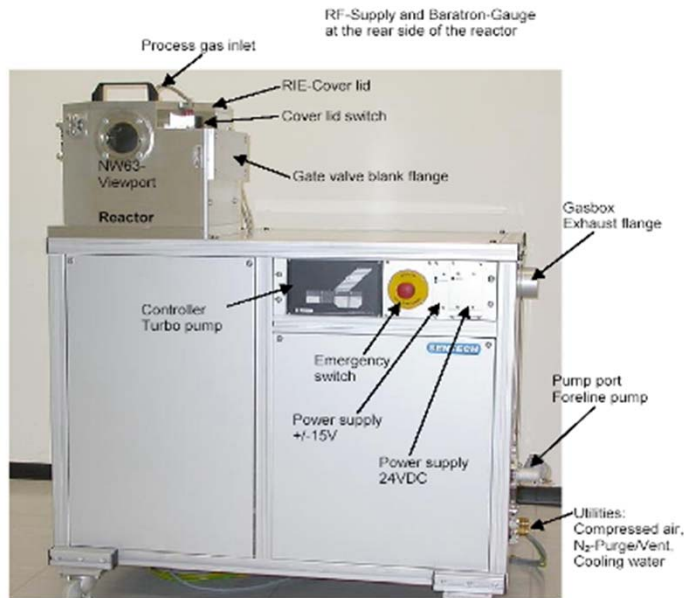
Ballistic FET on graphene featuring strong NDR



NDR behavior of the graphene FET with oblique gate at VTG = 0.5 V (dashed red line), 1 V (dotted blue line), and 1.5 V (solid red line).



Reactive Ion Etching (RIE) Plasma Etcher- Etchlab 200



Applications:

- the etching of dielectrics (SiO_2 , Si_3N_4),
- semiconductors (Si),
- polymers and metals (Au, Pt, Ti, Ni).



ICP-RIE – PlasmaPro 100 (Oxford Instruments, UK)



Applications:

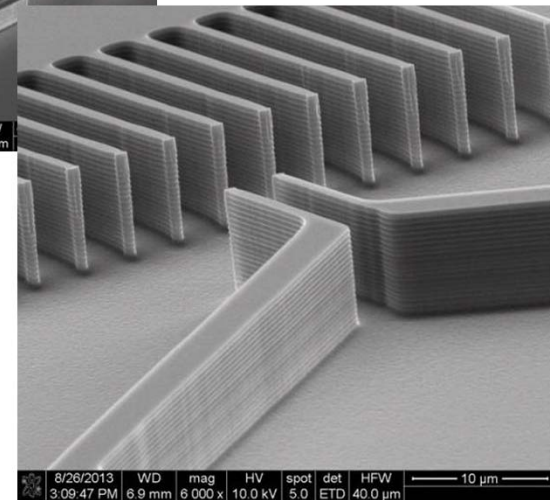
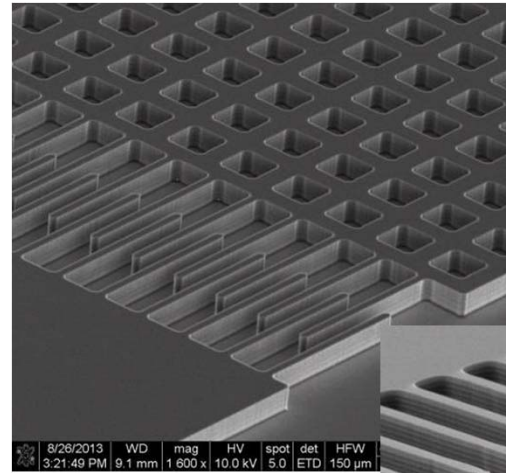
Etching:

- Bosch process for silicon
- Cryogenic process for silicon
- Bosch Process for SiC

Single wafer processing.

Can process 4" or smaller wafers, even small pieces.

Process gases: SF₆, C₄F₈, O₂, Ar.



Anisotropic etching of Si with perfectly vertical walls



Wafer Bonder System- SB6L- Wafer - Substrate Bonder System (Suss MicroTec)

Equipment is used to provides a semi-automated platform for multiple bonding processes that handles wafers up to 100 mm and supports various substrate types and sizes.

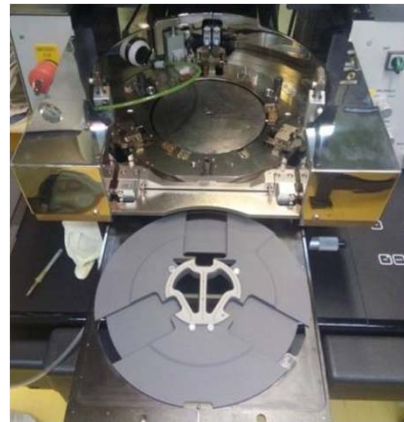
The SB6L is suitable for packaging as well structuring meeting the requirements for MEMS, LED, advanced packaging, 2,5D integration and 3D integration.

GENERAL CHARACTERISTICS:

- Lower hot bond chuck with temperature control from ambient to 500°C
 - Negative High Voltage DC power supply for Anodic bonding (up to -2000V)
 - Flexible process: can accommodate polymer and adhesive bonding of different substrates
- Bonding processes:

- Silicon to glass
 - Pressure/heat assisted polymer bonding
 - Adhesive/pressure/heat assisted bonding
- PERFORMANCE:

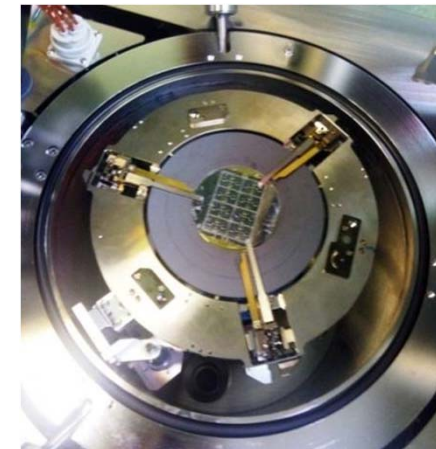
- temperature repeatability $\pm 3^{\circ}\text{C}$
- temperature uniformity $\pm 1.5\%$
- up to 8kN applied bond force
- process vacuum pressure down to $5 \cdot 10^{-4}$ mbar



Alignment substrates on MA6



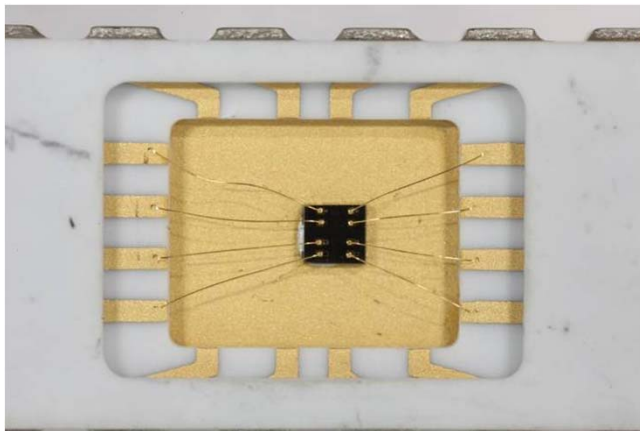
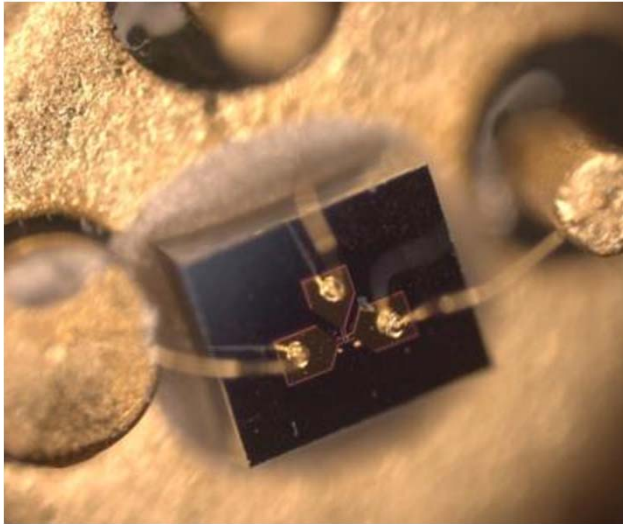
Microfluidics device encapsulated with borosilicate glass



Alignment substrates on SB6L



Wire Bonding



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