FEMTO-ST

MIMENTO

Technology Center

femto-st
SCIENCES & TECHNOLOGIES

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FEMTO-ST a joint Research Institute from

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UNIVERSITÉ DE FRANCHE-COMTÉ

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École Nationale Supérieure de Mécanique et des Microtechniques

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université de technologie Belfort-Montbéliard

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FACILITIES SPONSORS

RENATECH
French national nanofabrication network

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avec le Fonds européen de développement régional (FEDER)

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Doubs
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Grand Besançon Métropole

OUR CLEANROOM

MIMENTO technology center is identified as a reference centre for **Micro-nano-optics**, **Micro-nano-acoustics**, **Micro-Opto-Electro-Mechanical Systems** (MOEMS) and **Micro-Robotics**.

A few figures:

865m² of cleanroom (ISO5 to ISO7 classes)
15 engineers and technicians
17 M€ of high technology equipments

How to work with us:

Within the framework of the French technological centres opening (Renatech network), the FEMTO-ST Institute is committed to support at MIMENTO projects from external laboratories or from industrial partners for research collaboration. Each request will be examined by a local committee and will lead to a discussion with the technical staff to check the feasibility of the project, its cost and the fabrication time. Depending on the technological project, external people will be invited to perform themselves some technological steps in the cleanroom.

To submit a project: **www.renatech.org/projet**

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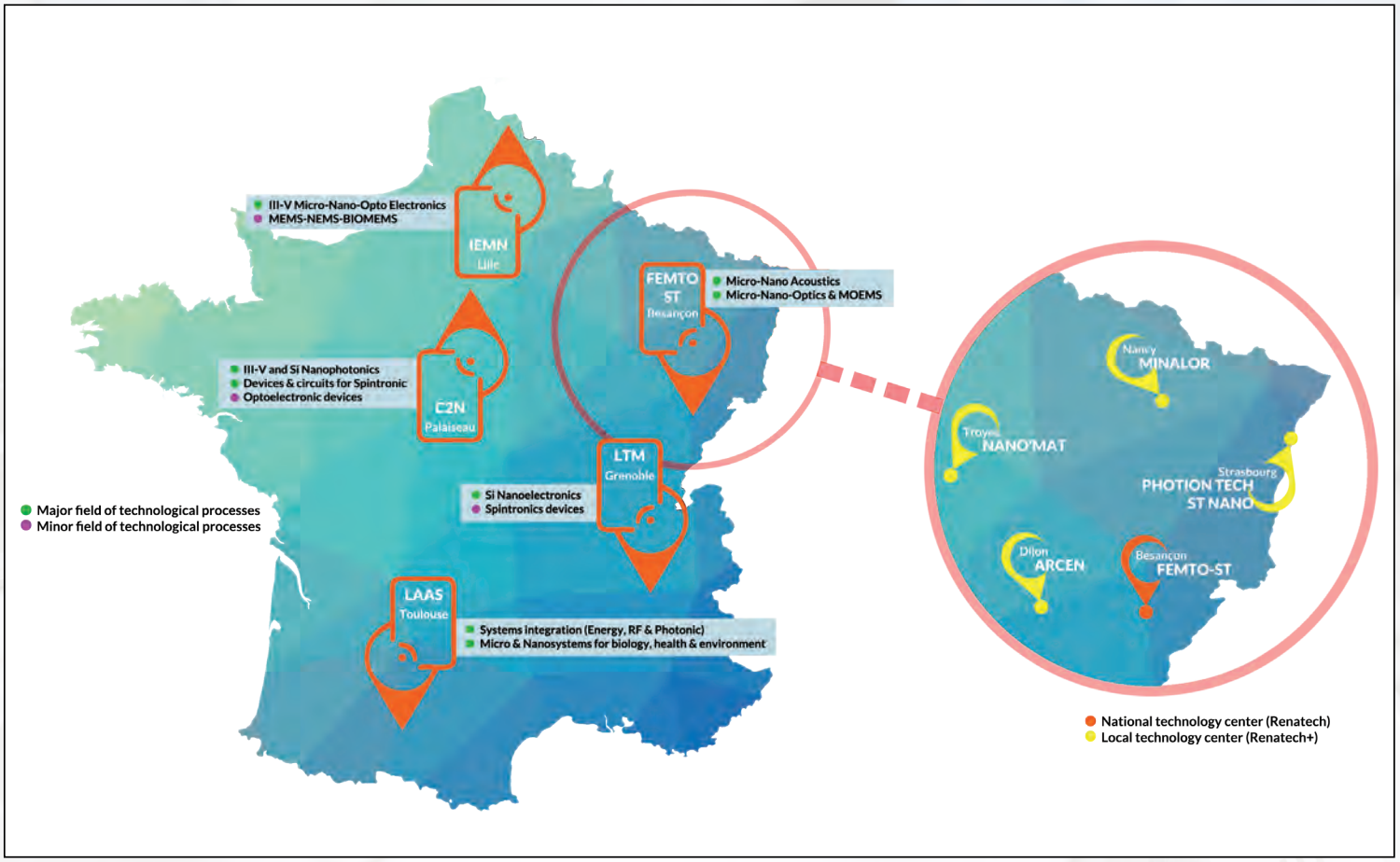
RENATECH NETWORK



MIMENTO is a member of the "RENATECH" network (French national network for large facilities involved in technological research in the field of micro and nanotechnology). This network is a partnership between five CNRS academic technology centers (LTM (Grenoble), C2N (Orsay / Marcoussis), IEMN (Lille), LAAS (Toulouse), FEMTO-ST (Besançon)) and CEA – LETI (Grenoble). The purpose of this network is to support French research by providing access to fabrication facilities and technology experts for interested research teams. It is also open to regional, national and international industrial partners for research collaboration.

Regionally, the FEMTO-ST Institute is associated with the "Pôle des Microtechniques" (a regional cluster of microtechnology-based companies and research centres) and with the proximity Technological centers of Dijon, Nancy, Strasbourg and Troyes. It is also a partner of The Competencies Centre in Nanosciences and Nanotechnology Grand Est (C'Nano Grand Est).

WHAT DO WE OFFER ?

Our high-end multidisciplinary micro & nanofabrication facility is your partner for carrying out **Research and R&D projects in micro & nanotechnology**

ACCESS to high-end micro & nanotechnology equipment

Basic and advanced **TRAINING** on technology processes

mimento
FEMTO-ST CLEAN ROOM

ADVISING from our microtechnology experts with years of experience

SAME ACCESS RIGHTS to internal, academic or industrial users

AN ACCESS TO INDUSTRY

DIRECT ACCESS

Including company staff training

DEVELOPMENT PROJECT

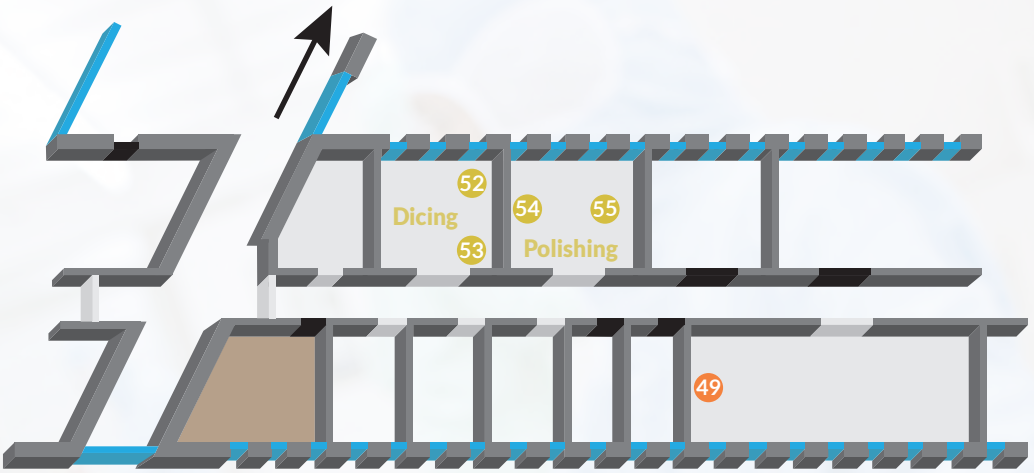
Request using standard technology
Service provided by FEMTO-Engineering

RESEARCH PROJECT

Exploratory project in partnership with FEMTO-ST research team

MAIN BUILDING

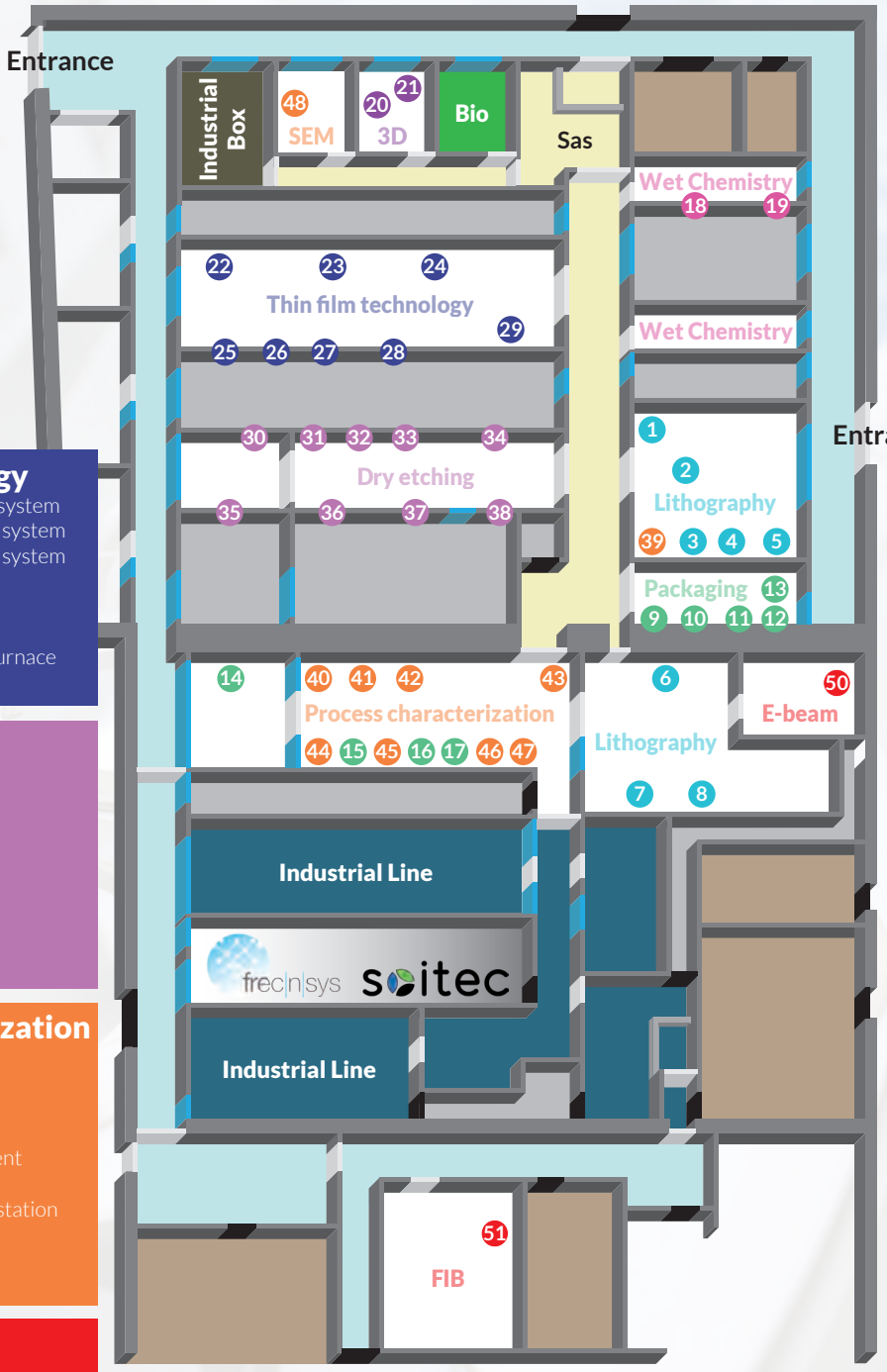
Main Entrance & Temis Innovation Building



Process characterization
49: MEMS analyser

Dicing / Polishing
52: High precision dicing saw 8"
53: Dicing saw 4"
54: Lapping and polishing system
55: CMP system

TEMIS INNOVATION BUILDING



Thin film technology
22: RF magnetron sputtering system
23: DC magnetron sputtering system
24: DC magnetron sputtering system
25: E-Beam evaporator
26: ICPECVD
27: E-Beam evaporator
28: Oxidation and annealing furnace
29: RTP system

Dry etching
30: Stripping tool
31: RIE-CCP
32: Stripping tool
33: Surface treatment system
34: DRIE-ICP 4"
35: Si DRIE-ICP 6"
36: Si DRIE-ICP 4"
37: Si DRIE-ICP 4"
38: Chlorine ICP 4"

Process characterization
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44: Contact angle metrology
45: Semi automatic RF probe station
46: Stress measurement
47: Manual DC probe station
48: SEM & EDS

Nanotechnology
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51: FIB

3D laser microfabrication
20: High resolution 3D printer
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19: HF acid bench

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2: Metrology platform
3: UV alignment system
4: DUV alignment system
5: Auto spin-coater
6: Mask generator
7: Spray coater
8: Cleaning system

Integration / Packaging
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15: Wire bonder
16: Die bonder
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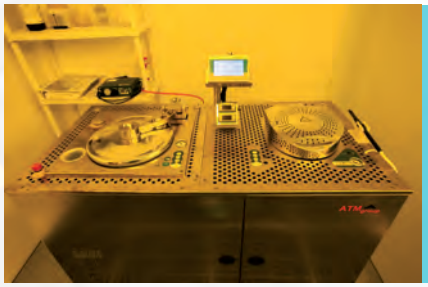
1 Spin-coater with integrated hot plate

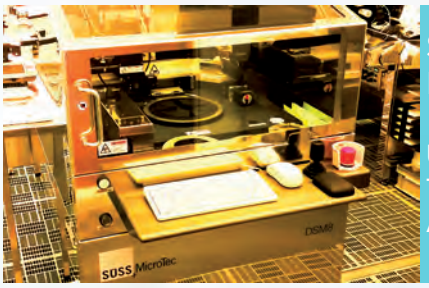


Solar-Semi
OC ST22

Use:
Photoresists spin coating

Spin speed: ≤ 7000 rpm
Cover: Close, middle or open (with some speed limitations)
Wafer Chuck: diam. 100 mm max and small pieces (only vacuum fixation)
Recipes: Selection and edition with touch screen display
Hot Plate: 250 °C max, diam. 152 mm max
Vacuum contact baking

2 Semi-automatic metrology platform

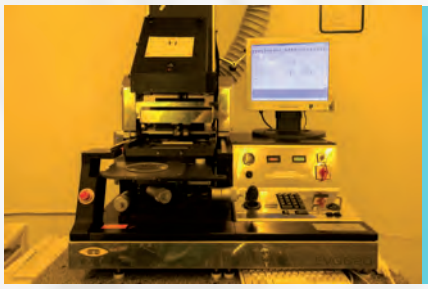


Süss Microtec
DSM8 GEN2

Use:
Top & bottom / Top & top Alignment control

Substrate size: 4'' & 6'' circular wafers
Substrate thickness: from 200 µm to 1000 µm
Front to back measurement accuracy: 0.2 µm
Accuracy: Tool induced shift compensation by wafer & pattern rotation
Graphical user interface: Including graphical display of results
ASCii output files (.CSV)

3 UV Double-side alignment system

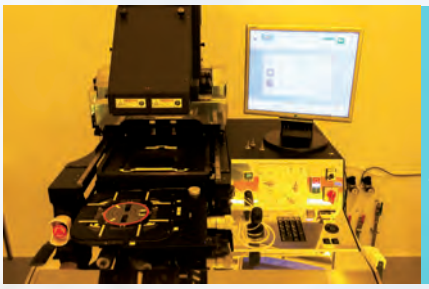


EVG
620

Use:
Top and bottom side alignments
Alignment for bonding

Resolution: Vacuum ≤ 0.8 µm
Hard Contact ≤ 1.5 µm
Soft Contact ≤ 2.0 µm
Proximity ≥ 5.0 µm
Mask size: 4" and 5"
File: gdsii
Alignment stage: Manual precision micrometers
Alignment accuracy: Top side alignment: ± 1.0 µm
Bottom side alignment: ± 1.25 µm
Substrate size: 2", 3" and 4"
Thickness: 0.1 to 2.5 mm (more on demand)
Exposure: Broadband (mercury arc lamp: 350 W)
Long pass filter for SU-8 photoresist
Time / Time interval
Sector exposure

4 DUV Double-side alignment system



EVG
620

Use:
Top and bottom side alignments

Resolution: Vacuum ≤ 0.8 µm
Hard Contact ≤ 1.5 µm
Soft Contact ≤ 2.0 µm
Proximity ≥ 5.0 µm
Mask size: 4" and 5" glass
5" flexible film
File: gdsii
Alignment stage: Autofocus and automatic positioning
Manual precision micrometers
Alignment accuracy: Top side alignment: ± 1.0 µm
Bottom side alignment: ± 1.25 µm
Substrate size: 2", 3" and 4" and small pieces (≥ 7x7 mm²)
Thickness: 0.1 to 2.5 mm (more on demand)
Exposure: Broadband (mercury arc lamp: 500 W)
Long pass filter for SU-8 photoresist
Time / Time interval
Sector exposure

5 Automatic spin-coater, baking and developer

ACS
200 GEN3

Use:
Adherence promotor
Photoresist coating
Photoresist development

System: Cassette to cassette (high throughput fully automated)
Substrate size: 3" & 4" circular wafers
Resists: 4 dispense lines + 1 syringe (thick resist)
Baking: 4 hot plates (contact and proximity mode)
Developer: 3 developer lines (TMAH, KOH & PGMEA)
Spray and puddle
Recipes: Library of recipes

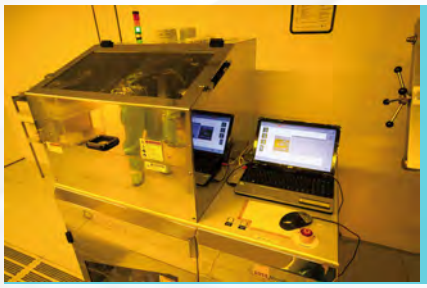
6 Optical mask generator

HEIDELBERG
DWL200

Use:
Optical masks
Direct exposure
3D photolithography

Features: Resolution 0.8 µm
Files format: gdsii, CIF, DXF, GERBER
Writehead 4 mm/10 mm
Substrates: Mask soda lime 7*7*0,12
Mask Quartz 6*6*0.25
Mask soda lime 5*5*0.09
Mask soda lime 4*4*0.09
Wafer 4'' and 3''
Chuck: Stage X/Y with vacuum
Optics: Laser He-Cd (λ = 442 nm, 180 mW)

7 Spray Coater



Süss Microtec
Alta Spray

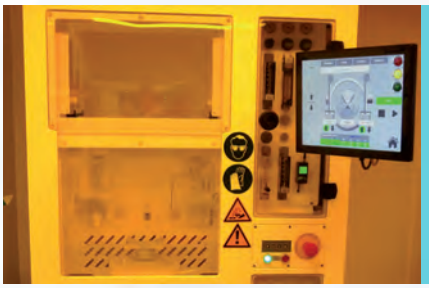
Use:
Conformal resist coating on substrate with high topology

Resist thickness: Standard process: 5 µm
Other process: several tens of microns

Parameters: Dilution and solvent
Resist flow
Speed of the nozzle
Number of meanders
Chuck temperature
Nitrogen pressure
Distance between nozzle and substrate

Nozzles: 2 (one dedicated for S1813)
Process time: 5 minutes (for 5 µm)
Resist dilution: Acetone
MEK
Substrate size: 4" max

8 Semi automatic cleaning system



Solar-Semi
QS W300

Use:
Mask & wafer cleaner

Chuck by clamp: Wafer 3", 4" and 6"
Mask 4", 5" and 7"

Cleaning: Deionised water (30 to 180 bars)
Heated solvent (80 °C max)
Piranha

Back side rince

Integration / Packaging

9 Wafer aligner-bonder 6"

AML
AWB-04

Use:
Flexible automatic multi-process system
No flags clamping

Features: In-situ wafer alignment & radical activation of surface
Surface treatment (plasma, vapors) & UV exposure
Alignment accuracy ±1-5 µm (bond type, wafers)

Chamber: Vacuum min. 1E-6 mbar
3 process gases: N_2, O_2, Ar / Vapor: DI water

Substrat: Wafers: 3", 4" and 6" / chips: 10 x 10 mm²
Min. thickness of top wafer: 0.2 mm
Max. thickness of wafer stack: 30 mm

Voltage: Max. bonding voltage/current: 2.5 kV / 40 mA
Constant voltage or constant current operation

Heating: Source: Halogen lamps, max. rate ~1.6 °C/s
Top/Bottom temperature: max. 560 °C, 1 °C step

Contact Force: Hydraulic load cell 0-40kN, resolution ± 5 N
Top Tungsten Platen: max. 40 kN
Top Graphite Platen: max. 1 kN (anodic bond.)

Cooling: Natural or forced by N_2 flow (≤200 °C)

10 Megasonic wafer cleaner & Wafer bonding inspection systems

CL200 &
IR200

Use:
Final rinsing of wafers before bonding (reduction of particles)

Features: Dedicated for removing particles from wafer surface
by megasonic DI-water jet
Drying the wafers by IR heating and spinning
Vibratory motor and tilt applied to align wafers
Pre-bonding of wafers

Wafers: Size of round wafers: 2", 3", 4", 5" and 6"
Size of square substrates: 4x4", 5x5"
Via-holes not allowed (vacuum chucks)

Chucks: Vacuum chucks
Spin speed: max. 4000 rpm

Inspection IR System: Infra-Red inspection system for bonded Si stack
IR Camera, manually adjustable Optical Zoom
Field of view: diam. 75 mm max

11 Multi-wafer bonder 4”

AML
402P

Use:
Special bonding process
(Anodic, Eutectic, Thermo-Compression & Direct)

Features: Wafer-level bonding (**NO FLAGS**, clean processes only)
Big separation between wafers (up to 10 mm)
In-situ wafer alignment: Visible/IR (± 5 / 20 µm)
Control of atmosphere with inert gas (He, Ne)
Chamber: Vacuum down to 1E-6 mba
Wafers: Size of 3” and 4” (Si, SOI, Glass, $LiNbO_3$, Quartz)
Max. thickness of wafer stack: 8 mm ±0.5 mm
Min. thickness of top wafer: 0.4 mm
Heating: Top: Halogen lamps (max. 560 °C)
Bottom: Resistance heater (max. 560 °C)
Fast or controlled heating
Voltage: Max. bonding voltage/current: 2.5 kV / 40 mA
Constant voltage or constant current operation
Contact Force: Top Graphite Tool: max. 500 N (anodic bonding)
Top Molybdenum Tool: max. 2.5 kN (1E-5 mbar)
Cooling: Natural or controlled cooling

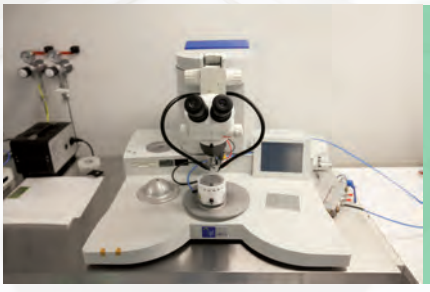
13 Plasma surface activation system

Nanoprep
NP12

Use:
Surface activation for low-temperature bonding applications

Features: Activation in cold plasma (low temperature, ambient conditions), based on dielectric barrier discharge
Very fast process (<<1 min)
Plasma: Oxygen, nitrogen, argon
Power: max. 500 W (typ. 200 W for Si wafer)
Programmable number of passage
Wafers: Silicon, Glass, Quartz, LiNbO3 ...
Wafers with metallic layers **NOT ALLOWED**
Size range: 10 mm up to diam. 300 mm
Thickness: typical 0.5 mm, 1.0 mm
Chuck: Vacuum fixation of substrate

15 Semi-automatic wire bonder

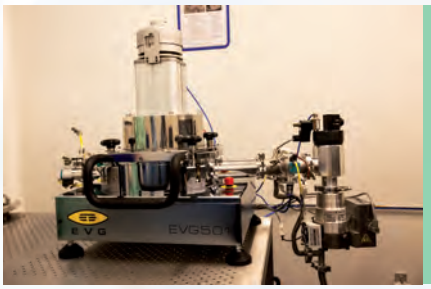


TPT
HB-16

Use:
Wire bonding of electronic components

Features: Ball, edge , bump & ribbon bonding. Stud bump fabrication
Bonding Tool: Au wire (25 & 19 µm) or Al wire (25 µm)
Ultrasonic Power: 0 – 10 W (63.3 kHz)
Bond Time: 0 – 10 s / Bond Force: 5 - 150 cNm
Motorized and Programmable Z-axis (17 mm), Y-axis (10 mm)
Electronic Ball Size Control (typical diam. 75 µm)
Programmable Loop Profile
Chuck: Heated stage (diam. 90 mm)
Mechanical/Vacuum substrate fixation
Height range: 70-90 mm
Heating: ambient to 250 °C
Optics: Optical Microscope 20x Optical Zoom

12 Multi-wafer bonder 4”



EVG
501

Use:
Standard bonding process
(Anodic, Eutectic, Thermo-Compression, Adhesive & Direct)

Features: Wafer-level bonding
Separation set by **3 FLAGS** (thickness 50 µm or 200 µm)
Alignment of wafers possible in EVG601 (±5 µm)
Gas: Vacuum down to 1E-4 mbar (turbo pump)
Purge gas: N_2 / Process gases: N_2
Wafers: Size of 3” and 4”
Silicon, SOI, Glass, LiNbO3, Quartz
Max. thickness of wafer stack: 6 mm
Heating: Top: Resistance heater (max. 550 °C)
Bottom: Halogen lamps (max. 550 °C)
Voltage: Max. bonding voltage/current: 2 kV / 50 mA
Force: Quartz Tool: max. 2 kN (anodic bonding)
Stainless steel Tool: max. 4 kN
Cooling: Natural or ramp cooling

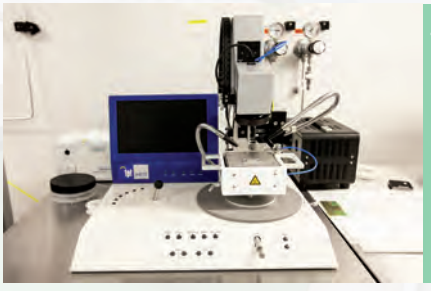
14 Automatic flip-chip bonder

Süss Microtec
FC250

Use:
Die to substrate bonding and interconnecting

Features: Automatic pick & place of die
In-situ die-to-substrate alignment
Bonding of components with excellent process control (heating/cooling rate, compression force, time)
Operations Modes: Bonding – Interconnecting, Hot embossing, Dispensing
Technical specifications: Size of die: 0.2-10 mm, height max. 2 mm
Size of substrate: 0.5-200 mm
Heating: 20 °C up to 500 °C (die) & 450 °C (substrate)
Force: 0.3-500 N

16 Pick and place die bonder



TPT
HB-70

Use:
Die bonding, Assembly of micro- components

Features: Die adhesive bonding, assembly of micro-components
Epoxy stamping, epoxy pneumatic dispensing
Manual or semi-automatic modes
Die Tool: Pick Up vacuum tools available:
Metal Tip: 100 µm, Hole 50 µm
Plastic Tips: 500 & 1016 µm, Hole 200 & 508 µm
Force range: 1-100 cN
Motorized and Programmable Z-axis (25 mm)
Die Chuck: Large heated stage (100x100 mm^2)
Mechanical/Vacuum substrate fixation
Height range: 70-90 mm
Heating option: ambient to 250 °C
Rotatable table with alignment ± 10 µm
Option: Mechanical stage for miniature substrates
Optics: HDMI Camera 11x Optical and 125x Digital Zoom
Epoxy: Stamping capillary (dot < 150 µm, ceramic tip)
Stamping tool (cross, dot ~1 mm, metal tip)

17 Mechanical micro bond tester

Nordson
DAGE 4000 Plus

Use:
Testing of:
Electrical interconnects
Bonding quality

Features: Mechanical testing of micro-components in both PULL & SHEAR modes
Automatic surface detection for SHEAR
Vacuum/mechanical holder
Cartridges: P100g for Wire Pull Destructive test
S250g for Ball Shear Destructive test
S5Kg for Die Shear Destructive test
S200Kg for Die Stud Pull Destructive test
X-Y stages: High force, high precision motorized stage
Working surface: 280x280 mm²
Travel range: max. 160 mm
Optics: Microscope Leica S9D, magnification up to 69.3x
Trinocular camera
Substrate: 3'', 4'' and 6'' wafers
Non-standard: 5-70 mm²

Wet chemistry

18 Ni electroplating system

Technotrans
Microform 100

Use:
Hard mask for etching
Items in nickel
Vias filling

Type of deposit: Matt Nickel
Substrate: Wafer 4 inches
Stress: About 90 MPa
Speed of growth: 1.5 A/dm² = 20 µm/h
10 A/dm² = 100 µm/h

Roughness: Ra (µm) 0,211
Rq (µm) 0,274
Rt (µm) 1,925

19 Hydrofluoric acid bench

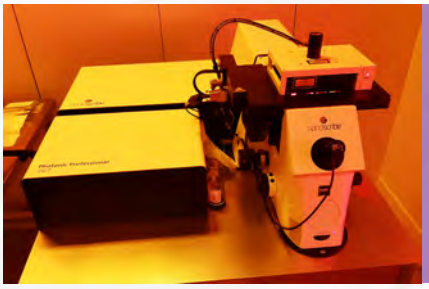
Idonus
HF VPE-100

Use:
SiO_2 and Ti etching
Vapor HF Etching

Solutions: BHF
HF 48%
Etch Speed: SiO_2 by BHF: 57 nm/min at 20 °C
BF33 by HF 48%: 4.2 µm/min
BF33 by vapor HF: For 9 µm: 15 min (0,6 µm/min)
For 120 µm: 80 min (ou 1,5 µm/min)

3D laser microfabrication

20 High resolution 3D printer



Nanoscribe
Photonic Pro. GT+

Use:
3D laser µ-printing
2D & 2.5D lithography

Scanning: Piezo & Galvo modes
Writing: Dip-in Laser Lithography & Oil Immersion modes
Printing specs: Min 3D lateral feature size: 200 nm
Max object height: 8 mm
Build volume: 100x100x8 mm³
Minimum surface roughness Ra ≤20 nm
Scan speed ≤100 mm/s
Wafers: Fused silica (high resolution), Silicon substrates (large features)
Soda lime with ITO (mesoscale applications)
Photoresists: IP-Dip, IP-S & IP-L 780, IP-G 780 and IP-Q photoresins
Optics: 20X (2D), 10X, 25X & 63X (3D)
Files: 3D CAD (.stl) or GWL scripting

21 3D laser microfabrication system

FEMTOprint
f100 aHEAD Enhanced

Use:
3D micromachining of transparent materials & local index modifications

Features: Fabrication of highly accurate 2.5D / 3D geometries by femtosecond laser assisted wet etching method (FLAE)
Sealing, welding, selective ablation, micro-cracks generation
Modification of refractive index
Alignment to marks with ± 1-2 µm precision
Laser Source: Power: >5 W, λ=1030 nm
Controllable pulse duration & repetition rate
Writing head: Objective lens: 10x, 20x, 50x
Materials: Standard types of glass: Fused silica, Borofloat 33
Performances: Max. precision: ± 1 µm (2.5D), ± 2 µm (3D) / Aspect ratio >1:500
Substrate: 2", 3" and 4" wafers
Small samples (10x10 mm², 20x20 mm², 26x10 mm², 26x20 mm²)

Thin film technology

22 RF magnetron sputtering system

Plassys
MP 450S

Use:
Metal, Oxide &
Nitride deposition

Features: RF reactive sputter deposition of metallic targets to deposit:
Oxides (Al_2O_3, ZnO, SiO2) or nitride (AlN, TiN)
4'' and 6'' targets
Plasma cleaning/activation of the substrates
Heating substrate until 600 °C
Wafers: One 4'' or 3'' wafer per run (small samples as well)

24 DC magnetron sputtering system

Plassys
MP 700S

Use:
Metal deposition

Features: DC sputtering of 4'' metallic targets: Au, Cr, Ni reinforced magnetron
6'' Al and Ti target
3'' tilted Cu target
Plasma cleaning/activation of the substrates
Heating substrate until 600 °C
Enhanced thickness uniformity with the tilted target
Wafers: One 4'' wafer per run (max height: 4 mm)

26 ICPECVD

Sentech
SI 500D

Use:
Oxide & Si_3N_4 deposition
Good conformal
deposition

Features: Low temperature chemical vapor deposition of silica & silicon nitride
by means of ICP (Inductive Coupled Plasma)
He back-cooling & RF Ar plasma to: activate the surface
polarize the wafer
Wafers: 4'' or 3'' substrates

28 Oxidation and annealing furnace

AET

Use:
Thermal oxidation
& diffusion

Features: 3 different furnaces: one for wet or dry oxidation
one for titanium diffusion in $LiNbO_3$
one for annealing under N_2 or air up to 900 °C
Wafers: batch up to 25 wafers (3'', 4'' and 6'')

23 DC magnetron sputtering system

Plassys
MP 500

Use:
Metal deposition

Features: DC sputtering of 4'' metallic targets:
Au, Cr, Cu, Ag, Mo, Ta, Pt, Ti, W and Ni reinforced magnetron
6'' Al target
Plasma cleaning/activation of the substrates
Wafers: 4'' substrates (max height: 7 mm) on 4 diff. positions during the same run

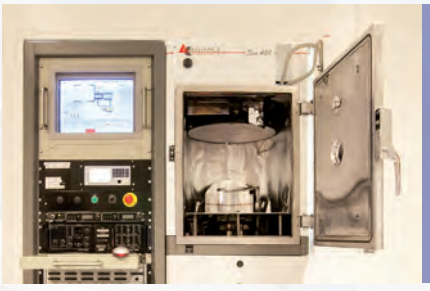
25 Electron-beam evaporator

Plassys
MEB 600

Use:
Metal & Oxide
deposition for lift-off
processes

Features: Electron beam evaporation of metals or oxide compounds (Al, AlCu, Au, Cr, Ni, Ag, Pt, Au, Ti, Ta, SiO_2, Al_2O_3, TiO_2)
End-Hall ion source for surface activation & enhanced layer density
Wafers: 5 wafers of 4'' or 7 wafers of 3'', double planetary substrate holder

27 Electron-beam evaporator



Alliance Concept
EVA 450

Use:
Metal deposition
for lift-off processes

Features: Electron beam evaporation of metals (Au, Cr, Ti, Al)
Wafers: 3 wafers of 6'', 5 wafers of 4'' or 7 wafers of 3''

29 Rapid thermal processing

Annealsys
AS-Premium RTP

Use:
Densification &
Crystallization
Contact annealing

Features: Densification or crystallization of deposited thin films
Rapid thermal oxidation or nitriding
The RTP processes can be performed in: atmospheric pressure
under vacuum (~10-3 mbar)
Wafers: 6'' wafer or 4'' and little samples in a susceptor
(Tmax = 1250 °C, Ramp ≤ 20 °C/s)
No metal in contact with SiC (Peek tweezers)

30 Stripping tool

Tepla
GIGABatch360M

Use:
PR stripping
Surface activation

Features: Resist stripping
Quartz holders for 25 wafers from 100mm to 150 mm
& Aluminium shuttles (from pieces to 150 mm wafers)
Microwave source: 100 to 1000W
Gas : O2, CF4, Ar
End point detection : Intensity

31 RIE-CCP system

CORIAL
200-R

Use:
Nano-metric & sub-µ etching on variety of materials

Features: CCP source: 600 W
Clamping chuck: Mecanic
Gas: SF_6, C_2F_6, O_2, CHF_3, Ar
Mask: PR, SiO_2, Metallic masks are allowed
Materials: Dielectrics, SC, piezo-electric ...
Wafers: 4'', samples can be glued on 3'' or 4'' Glass carrier wafer
End point detection: EPD Interferometry HORIBA Jobin-Yvon
(wavelength 673,7 nm, spot size 20 µm)

32 Stripping tool

Muegge
R3T

Use:
Thick photoresist remover (SU8), descum and surface Activation

Features: Pure chemical etching
Remote plasma microwave source 1 kW
Process temperature: 20 to 70 °C
Only very slight attack to Si and Si compound
Gas: O_2, N_2 and CF_4
Mask: No attack to metals (Ni, Au, Cu ...)
Materials: Mainly resist remover
Wafers: Substrate size up to 240x240 mm

33 Asher & surface treatment system

Nanoplas
DSB 6000

Use:
PR stripping
Surface treatment, preparation, functionalization

Features: ICP source: 600 W
Clamping chuck: No
Temperature Process for both chamber & substrate: 60 to 180 °C
Gas: O_2, Ar, SF_6, CF_4
Mask: PR, SiO_2, Metallic masks are allowed
Wafers: 4'', samples can be glued on 4'' Glass carrier wafer
End point detection: OES system can be used

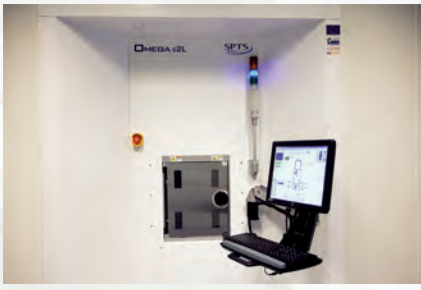
34 Multi-material DRIE-ICP system 4''

STS
APS

Use:
Dielectric, isolated & piezo-electric materials etching

Features: ICP power source: 3 KW
Bias power source: 1.5 KW
Process temperature: -20 to 40 °C
Clamping chuck: Mechanical
Gas: SF_6, C_4F_8, O_2, Ar, CF_4, He
Mask: PR, SiO_2, Metallic masks are allowed
Wafers: 4'', samples can be glued on 4'' carrier wafer
End point detection: OES system can be used

35 Si DRIE-ICP system 6''



SPTS
Rapier Omega C2L

Use:
Si deep, sub-micronic & isotropic etching
Vias etching

Features: ICP power source: 5.5 KW
Bias power source: 1.5 KW
Dual source
Process temperature: 0 to 40 °C
Clamping chuck: Electrostatic
Gas: SF_6, C_4F_8, O_2, Ar, N_2, He
Mask: PR, SiO_2
Wafers: 6'', samples can be glued on 4'' carrier wafer
End point detection: CLARITAS OES system integrated

36 Si DRIE-ICP system 4''

SPTS
Rapier

Use:
Si deep, sub-micronic & isotropic etching
Vias etching

Features: ICP power source: 5.5 KW
Bias power source: 1.5 KW
Dual source
Process temperature: 0 to 40 °C
Clamping chuck: Electrostatic
Gas: SF_6, C_4F_8, O_2, Ar, N_2, He
Mask: PR, SiO_2
Wafers: 4'', samples can be glued on 4'' carrier wafer
End point detection: CLARITAS OES systems integrated

37 Si DRIE-ICP system 4''

Alcatel
601E

Use:
Si deep etching
Si isotropic etching

Features: ICP power source: 2 KW
Bias power source: 0.5 KW
Process temperature: -20 to 30 °C
Clamping chuck: Mechanical
Gas: SF_6, C_4F_8, O_2
Mask: PR, SiO_2, Metallic masks are allowed
Wafers: 4'', samples can be glued on 4'' carrier wafer
End point detection: OES system can be use

38 Chlorine ICP system 4''

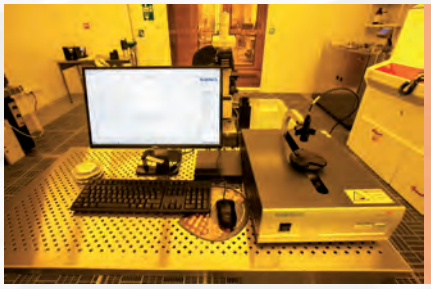
Trikon
Omega 201

Use:
Metallic materials & SC materials etching

Features: ICP power source: 0.6 KW
Bias power source: 0.6 KW
Process temperature: 0 to 45 °C
Clamping chuck: Electrostatic
Gas: Cl_2, NH_3, HBr, O_2, N_2, Ar, CF_4
Mask: PR, SiO_2, Metallic masks are allowed
Wafers: 4'', samples can be glued on 4'' Glass carrier wafer
End point detection: OES system can be used

Process characterization

39 Thin layer measurement system

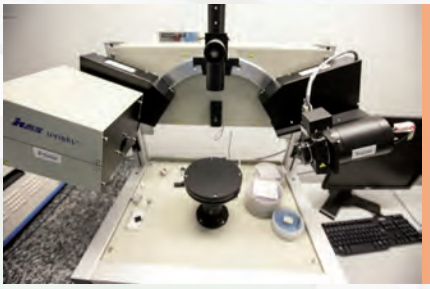


Filmetrics
F50-EXR

Use:
Automated film thickness measurment
Index mapping

Models: Spectral reflectance & Fast Fourier Transform
Thickness: From 20 nm to 250 µm
Wave-length range: 380 < λ < 1700 nm
Wafer chuck: Motorized rotation stage (diam. 100 mm max)
Vacuum substrate fixation
Mapping: Custom map patterns (polar, rectangular, linear...)
Acquisition speed: 2 pts/s
Spot size: 1.5 mm
Filter: High-Pass Filter (λ > 550 nm)

40 Spectroscopic ellipsometer

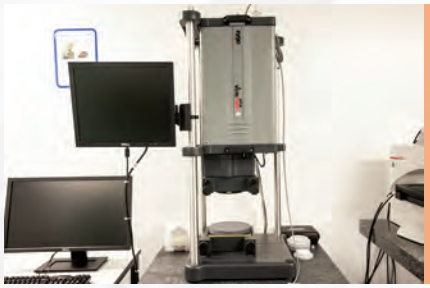


Jobin Yvon HORIBA
UVISEL-NIR

Use:
Optical measurements
Surface roughness
Material properties

Measurement capabilities: Thin film thickness: from 0.1 nm to >45 µm
Single layer or multiple layers thin-films
Lateral resolution (spot size): 50, 100 µm and 1 mm
Holder: 150 mm diam. with manual height (4 mm)
Tilt adjustment Maximum thickness: 20 mm
Materials: Transparent dielectric: SiO_2, TiO_2, Ta_2O_5, Si_3N_4, SiOxNy , polymers ...
Semi-conductors: Si, AsGa, ...
Metals
Optics: Spectral range: 245 nm < λ < 2100 nm
Goniometer: manually adjustable incidence angle from 55° to 90° by 5°

41 Fizeau interferometer

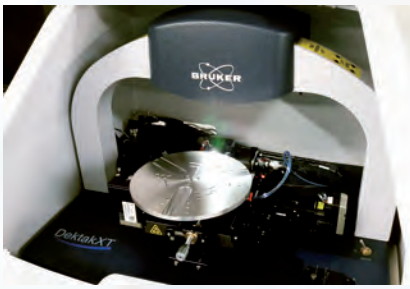


ZYGO
Verifire GPI XP/D

Use:
Measurement of surface profile & Roughness

Measurement capabilities: Z Resolution: <0.1 nm
XY resolution: 100 µm (100 mm field)
15 µm (15 mm field)
Z measurement range: >50 µm
Smooth profile with step < 300 nm
Sample: Large stage suitable for diam. ≤100 mm
Thickness range: 0 to 100 mm
Reflective materials: glass, silicon, metal…
Optics: Fizeau phase shifting interferometer
He-Ne laser (λ = 633 nm)
Camera 1000 x 1000 pixels
Motorized zoom x1 to x6 (not indexed)
Motorized focus (not automatic)

42 2D contact profilometer

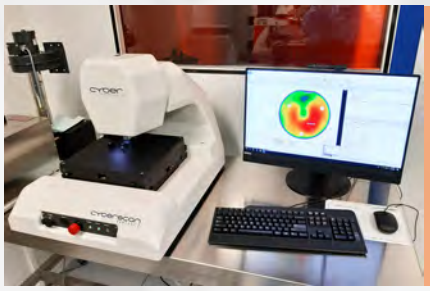


Bruker
DEKTAK XT

Use:
Step and roughness
3D mapping
2D Stress measurement

Stylus: Diamond tip 2 µm
Force: Adjustment: 0.03 to 15 mg
Vertical range: 1 mm
Minimum step measurable : few nm
Stages: 3 Motorized axes
X and Y: 150 mm / θ: continuous 360°
Wafer Chuck: 2'', 3'', 4'', 6'' & 8'' wafers
Scan Length range: 50 um to 200 mm with scan stitching capability
Sample thickness: 50 mm max

43 Wafer surface measurement

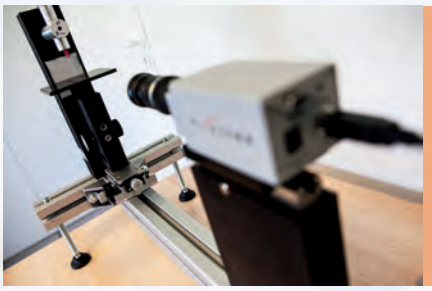


CyberTechnologies
Vantage 2

Use:
Surface measurement
Thickness measurement
Optical profilometry

Features: Max size: 200 mm / 40 mm thickness
Max measurement range: 10 mm
X & Y resolution: 50 nm
SCAN CT software - Various filters and measurements
Optics: Infrared interferometer
Confocal white light sensor
Holding: Pins (no vaacum)
Materials: Si, Glass, Quartz, $LiNbO_3$, $LiTaO_3$, Sapphire

44 Contact angle metrology

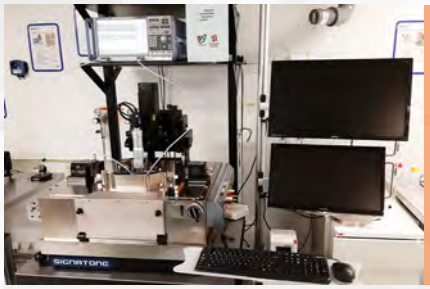


GBX
MCAT

Use:
Dynamic contact angle
Liquid surface tension
Wetting hysteresis

Measurement capabilites: Precision: ± 0.1° on reference droplet
± 2° on standard droplet
Angle measurement range: 0 – 180°
Surface tension range: 0,5 – 1000 mN/m
Dynamic measurement: 50 images/s
Borosilicate glass or plastic syringe with Teflon tip
Liquids: DI water (others possible)
Sample stage: Large stage suitable for diam. 100 mm
Thickness range: 0-60 mm
Z-table with fine adju stment X screw
Optics: USB Camera / Optical x10 Zoom / Backside LED illumination

45 Semi automatic RF probe station



SIGNATONE

Use:
Automated mesurement
Electrical RF
(100kHz to 20GHz)

Features: Temperature: From -20 °C to 150 °C
Chuck RF: Motorized X,Y,q (f = 200 mm max) with vacuum fixation
Mapping: Custom map: site & sub-site
Acquisition speed: 50 mm/s

46 Thin film stress measurement system

FSM
500 TC

Use:
Stress measurement
Thermal expansion coef.
Wafer bow height

Features: Measurement of the wafer curvature before and after film deposition
Stress range: 1 MPa to 4 GPa
Wafer sizes: 200 mm or smaller
Laser: Dual wavelength (780 nm, 650 nm) diodes
Repeatability: 1.5 % (1σ) of average
Scan & Mapping: Scan range: Up to 170 mm
Scan line: Single scan line at any wafer orientation
Mapping: Multi scan line mapping by manually rotating wafers
Max of 6 line mapping with 30° between each line
Heating: Maximal temperature: 450 °C
Heating and cooling ramps: max 6 °C/min

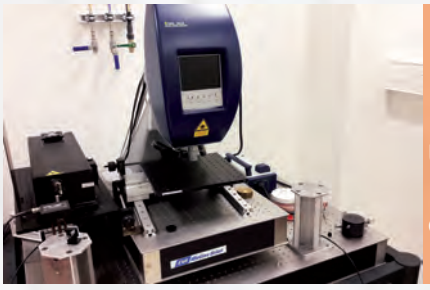
47 Manual DC probe station

Cascade Microtech
MPS150

Use:
Manual probing
DC parametric test

Features: I-V & C-V coaxial chuck with +/- 3 µm planarity and 360° rotation
Single chip and wafer 150 mm max. (device biasing and vacuum switch)
X/Y movement <5 µm resolution and independant axis locks
4 DPP210-M-S DC magnetic positioners with coaxial probe arms
Tungsten tips probe PTT-120-25
Trinocular stereo zoom microscope 15x to 100x

49 MEMS analyser



Polytec
MSA-500

Use:
MEMS/MOEMS
dynamical analysis

Out of plane vibration LDV:
VD-09: wide bandwith Velocity Decoder (0 - 2.5 MHz),
max. velocity ± 10 m/s, typical resolution 0.02 - 0.7 µm/s/√Hz
VD-06: high res. & precision digital Velocity Decoder (0 - 350 kHz),
max. velocity ± 0.5 m/s, typical resolution 0.01 - 0.06 µm/s/√Hz
LDV (Laser Doppler Vibrometry):
DD-300: high freq. analog Displacement Decoder (-3 dB: 0.03 - 24 MHz)
Amplitude range limit: ± 75 nm, noise limited resolution < 0.05 pm/√Hz
In plane motion SVM (Stroboscopic Video Microscopy):
Frequency range: 1 Hz – 1 MHz
1.4 Mpixel (1392 x 1040) progressive scan camera,
IEEE 1394 FireWire interface
100 ns time resolution
L imited to repetitive motion and nanometer resolution
3D topography WLI (White Light Interferometry):
Z direction scan range: 250 µm
Z resolution <1 nm
Lateral resolution <1 µm (magnification dependent)
Mirau x10 objective

48 Environnemental SEM & EDS systems

ThermoFisher
Apreo S

Use:
High res. observations
3D reconstruction
Chemical analyses (EDS)

Features: Schottky Field Emission Gun
Landing voltage: 20 V to 30 kV
Current: 1 pA to 400 nA
High vacuum (10-4 Pa) and low vacuum (<500 Pa) modes
IR Camera / NavCam
Detectors: Everhart-Thornley SE detector
Trinity Detection System (T1/T2/T3) for SE and BSE (resolution <1 nm)
Retractable BSE detectors (CBS for high-vac. and GAD for low-vac.)
Low-vacuum SE detector (resolution <2 nm)
EDS SDD 30 mm² (qualitative and quantitative analysis, mapping)
Element detection from Be
CL detector for cathodoluminescence
Stage: Eucentric stage: 5 axes
X/Y: 110 mm / 110 mm, tilt: -15 to 90°
6" wafer compatible

Nanotechnology

50 Electron beam lithography system

Raith
E_Line

Use:
Electronic lithography

Filament: Schottky TFE
Spot size: < 2 nm @ 20 keV
Current: 5 pA – 20 nA
Stability: < 0.5 %/h

Resolution: Min feature size: 20 nm
Stitching: 60 nm
Overlay: 40 nm
File: gdsii

Stage: 100 mm x 100 mm x 30 mm
Detectors: In Lens, Everhart Thornley

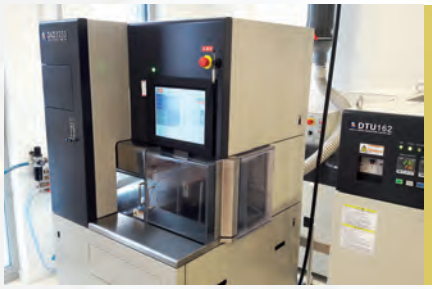
51 Focused ion beam system

FEI Helios
Nanolab 600i

Use:
Ion Beam Lithography
SEM observation
3D reconstruction

Electron column: Resolution <1 nm, 50 V-30 kV, 1 pA-22 nA
Ion column: Resolution <5 nm, 500 V-30 kV, 1 pA-65 nA
Stage: 150 mm x 150 mm x 10 mm
Detectors: In Lens, Everhart Thornley, BSE, Secondary Ions
Gas Injection system: Deposition: Pt –C – SiOx
Assisted Etching: I_2 – XeF_2
Others: 3D reconstruction (slice and view), Flood gun
Pattern generator: Raith Elphy Multibeam, drift correction, Overlay & Stitching
File: gdsii

52 High precision dicing saw 8”



DISCO
DAD 3350

Use:
Separation &
Structuration of chips
Circle cut process

Features: Substrate & Wafers can be processed
Max size: diam. 8” / 4.3 mm thick
Axes precision: 1 µm (X, Y & Z) / 1.0” (θ)
Speed feed: 0.1 to 10 mm/s
Water cooling
Holding: UV tape on porous vaccum chuck
Processed materials: Si, Glass, Quartz, $LiNbO_3$, $LiTaO_3$, PZT, Si_3N_4, Langasite, Langatate, Sapphire
Blades: Resin, Metal or Vitrified bond

53 Precision dicing saw 4”

DISCO
DAD 321

Use:
Separation &
Structuration of chips

Features: Substrate & Wafers can be processed
Max size: diam. 4” / 4.3 mm thick
Axes precision: 1 µm (X, Y), 5 µm (Z) / 1.0” (θ)
Speed feed: 0.1 to 10 mm/s
Water cooling
Holding: UV tape on porous vaccum chuck
Processed materials: Si, Glass, Quartz, $LiNbO_3$, $LiTaO_3$, PZT, Si_3N_4, Langasite, Langatate, Sapphire
Blades: Resin, Metal or Vitrified bond

54 Precision lapping & polishing system

Logitech
PM6

Use:
Optical polishing
Material thinning

Features: Substrate & Wafers can be processed
Max size: diam. 4” / 10 mm thickness
Thickness precision: 1 µm
Speed: 1 to 100 rpm
Automatic flatness control & fix
Pressure of work adjusted with loads
Plate size: diam. 300 mm
Holding: UV tape on vaccum chuck
Processed materials: Si, Glass, Quartz, $LiNbO_3$, $LiTaO_3$, PZT, Si_3N_4, Langasite, Langatate, Stainless steel
Abrasives: Aluminium oxyde, Silicon Carbide, Diamond, Colloïdale Silica

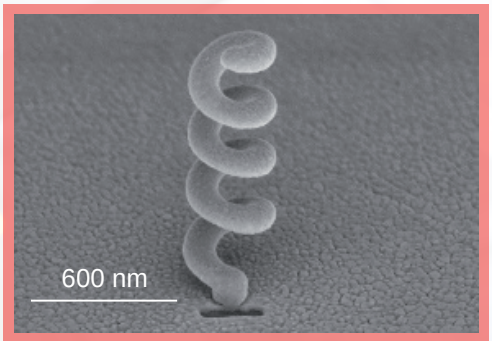
55 CMP system

Alpsitec
E460

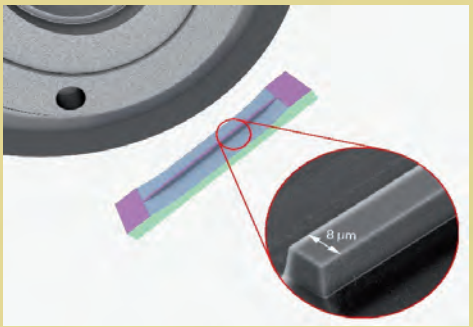
Use:
Wafer optical polishing
Hard materials process

Features: 2” to 6” Wafers can be processed
Process program (10 steps)
Max thickness: 10 mm
Speed: 1 to 120 rpm
Hydraulic pressure of work
Plate size: diam. 465 mm
Holding: Vaccum chuck
Ring (+ back pressure)
Processed materials: Si, Glass, Quartz, $LiNbO_3$, $LiTaO_3$, PZT, Si_3N_4, Langasite, Langatate, Stainless steel
Abrasives: Colloïdale Silica, Diamond on different nozzle

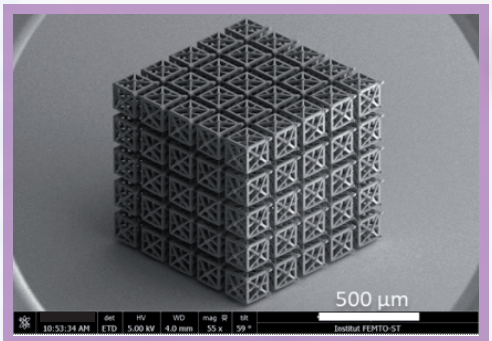
FEW ACHIEVEMENTS



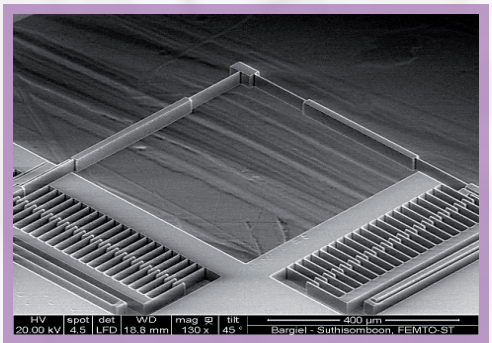
3D deposit
- FIB deposition -



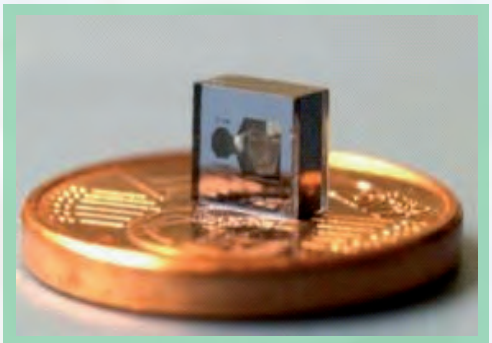
Precision dice & polish $LiNbO_3$ ridge
- Dicing -



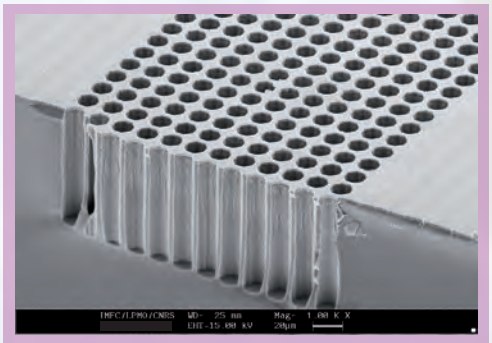
3D mechanical metamaterials
- High resolution 3D printing -



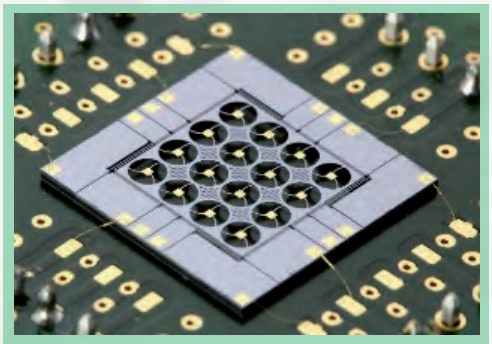
All-in-glass actuated micro-platform
- 3D laser micro-machining -



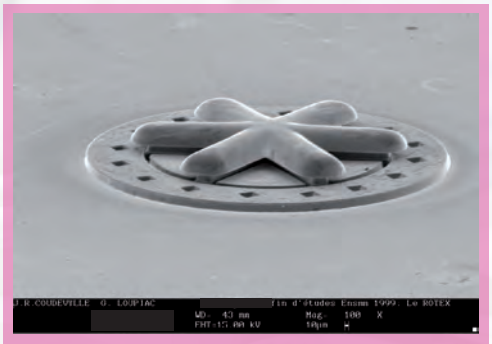
Cesium vapor microcell for MEMS atomic clock
- Multi-wafer Bonding -



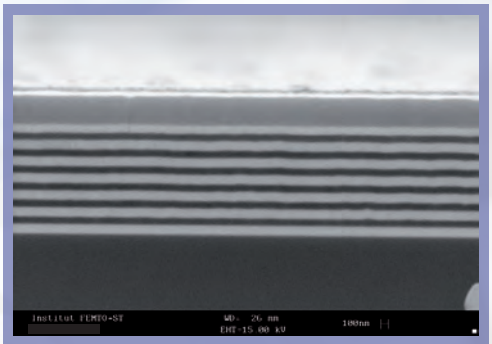
Phononic crystals
- Silicon DRIE etching -



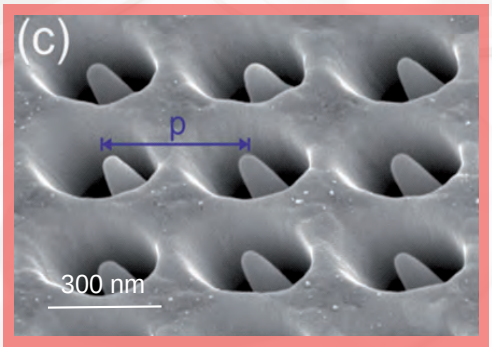
Vertical electrostatic comb drive actuator
- Wire bonding -



LIGA UV Ni micromotor
- Electroplating -

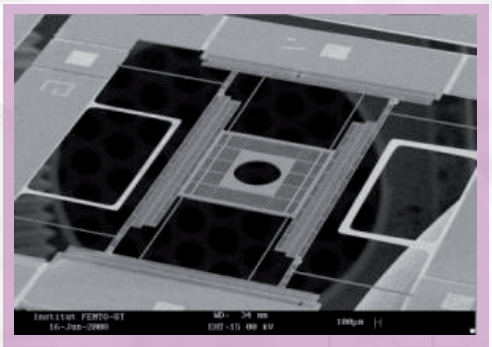


Multi-layer acoustic wave mirror
- Evaporation -



Milling with angle
- FIB milling -

Thinning and release of glass microlenses
- Thinning / Polishing -



Electrostatic X-Y microactuator
- Silicon DRIE etching -

Industrial line

This industrial production line is managed by frec|n|sys, a spin-off of FEMTO-ST, and 100 % subsidiary of SOITEC group. Its activity is dedicated to the fabrication of micro and nano-acoustic waves devices (SAW, BAW) for RF filters, resonators, delay-lines and sensing systems. In that context, the company develops new competencies in the field of MEMS, particularly exploiting SOITEC POI (Piezoelectric-On-Insulator) wafers obtained by Smart-CutTM techniques and combining single crystal piezoelectric thin films and silicon.

The main characteristic of this project consists in the exploitation of this pilot line, halfway between research and industry. Unprecedented initiative in France, this technology platform provides high yield processes for industry-oriented scientific investigations and unique opportunities for combining front-end research results and market-oriented developments.

The pilot line covers 200 sqm in ISO 5 conditions. The main equipments operated here are a high resolution lithography body9 i-line stepper, automatic coating and development tracks, a sputtering cluster (AlN, Mo), a high accuracy evaporation machine (Al, Ti, Pt, Au), a ferroelectric poling bench, an O2-plasma cleaner, several characterization instruments (CD SEM equipments, profilometers, tip-probing station, microscopes) and chemical benches for wafer surface processing and cleaning.

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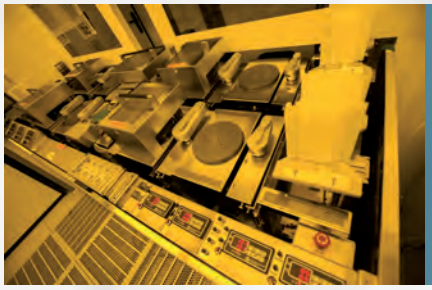
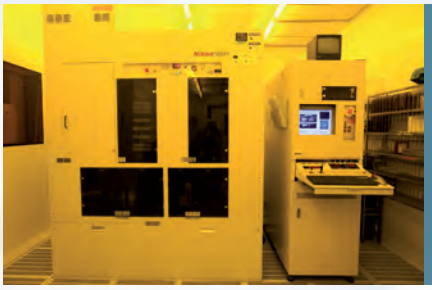
(Production manager)



SVG
88 series

Use:
Automatic coating & development tracks

Substrate size: 4'' & 6'' circular wafers



Nikon
NSR2005i9C

Use:
Stepper
(High resolution lithography machine)

Substrate size: 4'' circular wafers
Resolution: 350 nm

Balzers
BAK760

Use:
Evaporation

Substrate size: 2'', 3'', 4'' & 6'' circular wafers
Materials: Ti, Cr, Al, AlCu, Au, Pt

Trikon
Sigma 200

Use:
Cathode sputtering

Substrate size: 4'' circular wafers
Materials: AlN, Ti, AlCu, Mo

Süss Microtec
MA6-GEN4

Use:
DUV Aligner
(Contact photolithography machine)

Substrate size: 4'' & 6'' circular wafers
Resolution: <0.8 µm

Hitachi
S9220, S8840

Use:
CD SEM
(Critical dimension measurement system)

Substrate size: 4'' & 6'' circular wafers

soitec

www.frecnsys.fr

frec|n|sys

ISO 9001:2015
BUREAU VERITAS
Certification

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afaq ISO 9001 Qualité AFNOR CERTIFICATION

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