iemn

Institute of Electronics, Microelectronics and Nanotechnology

UMR CNRS 8520

Micro and Nano Fabrication Facility

Equipments - Staff - Expertise

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IEMN stands for Institute of Electronics, Microelectronics and Nanotechnology, a laboratory created in 1992 by four institutions: Lille1 University, University of Valenciennes and Hainaut Cambrésis, ISEN-Lille and CNRS. IEMN's research is performed based on a strong connection between its 5 technical facilities (Micro Nanofabrication, Near Field Microscopy, HF MEMS/NEMS characterisation, Telecom, ElectroMagnetic Compatibility) where cutting-edge equipments are operated by a highly qualified technical staff.

The scientific policy of the Institute is declined in five research Departments:

- Materials and nanostructures
- Micro and nanosystems
- Micro, nano and optoelectronics
- Circuits and communication systems
- Acoustics

At the forefront of education and technological research, and owing to numerous dynamic international collaborations, IEMN hosts PhD and graduate students coming from 30 different countries. Nearly 500 people work in IEMN fields of research, mainly Information Communication Technology and Nanotechnology. IEMN's devices can be found in Electronics, Energy, Biotechnologies, Sensors and Instrumentation applications. Moreover, as evidenced by numerous patents plus spin-off's creations, IEMN demonstrates its efficiency in promoting and facilitating technology transfer of innovations emanating from its research groups.

5 RESEARCH DEPARTMENTS AND 21 RESEARCH GROUPS

Materials and Nanostructures

- EPIPHY: EPItaxy and PHYsics of heterostructures
- NCM: Nanostructures, nanoComponents & Molecules
- PHYSICS: Nano materials physical properties

Micro, Nano and Optoelectronics

- ANODE: Advanced NanOmeter DEvices
- CARBON: Graphene based devices
- DOME: ***Dispositifs Opto et Micro Electronique quantiques***
- TeraHertz Photonics
- Silicon Microelectronics
- OPTOelectronics
- PUISSANCE: Microwave Power Devices
- SILPHYDE : ***SImuLation PHYsique de Dispositifs Electroniques et optoelectroniques***

Micro Nanosystems

- BioMEMS
- AIMAN-FILMS: ***Magnéto-Nano-Electronique – Structures actives, MEMS et flexibles Théragnostique ultrasonore - Micro-Fluidique***
- MAMINA: ***Matériaux et Acoustique pour les MIcro***
- NAM6: The Micro and Nano Systems group
- MITEC: Microtechnology and Instrumentation for Thermal and Electromagnetic Characterization
- ***NanoBiointerfaces***

Acoustics

- Acoutics Group
- MAMINA: ***Matériaux et Acoustique pour les MIcro et NAno systèmes intégrés****
- AIMAN-FILMS: ***Magnéto-Nano-Electronique - Structures actives, MEMS et flexibles Théragnostique ultrasonore - Micro-Fluidique****
- TPIA: ***Transduction, Propagation et Imagerie Acoustique****
- TELICE: Telecommunication, Interference and Electromagnetic Compatibility
- TPIA: ***Transduction, Propagation et Imagerie Acoustique***
- MITEC: Microtechnology and Instrumentation for Thermal and Electromagnetic Characterization
- Silicon Microelectronics*

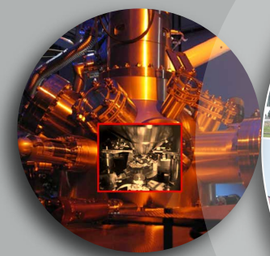
Circuits and Communications Systems

- COMNUM: Digital Communications
- CSAM: Circuits systems and Application of Microwaves

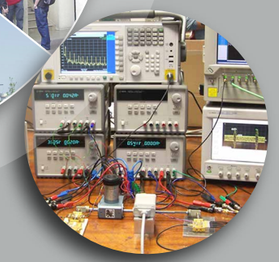
* Groups working in several research departments

HF and MEMS/NEMS Characterisation

ElectroMagnetic Compatibility



Near Field Microscopy



Telecom

MICRO NANO FABRICATION

IEMN's micro and nanofabrication facility is a 1600 square meter ISO6 certified cleanroom. Organised into six technological units: materials growth, deposition, lithography, etching, integration and characterisation, the facility is equipped with a full line of cutting edge technological tools supporting device fabrication.

Primarily conceived as an electronics-based research facility, IEMN's clean room is now renowned as a multidisciplinary facility allowing state of the art device and advanced system fabrication in many research fields ranging from photonics to bioMEMS or acoustics. 26 high skilled engineers and technicians work full time to support the research activities and collaborative projects aiming at exploring uses of micro and nanofabrication. The IEMN micro and nanofabrication facility steadily aims to be at the best international research level in micro and nanotechnology to efficiently support academic institutions and companies that require the use of its large clean-room infrastructures. Thus, IEMN is part of RENATECH, the french national network of large technological facilities, that is an integrated partnership of 6 CNRS laboratories in the field of micro nanotechnologies. RENATECH facilities are opened to both academic and industrial partnerships. In this context, IEMN hosts innovative projects in the best possible conditions by sharing and providing the most advanced know-how in the micro and nanotechnology fields through an access to high technology equipment, staff expertise as well as required training support.

CONTENTS

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NANORA
Nano Regions Alliance

RENATECH

cnrs · Centrale Lille · ISEN école d'ingénieurs Lille · Université de Valenciennes et du Hainaut-Cambrésis · Université de Lille 1

Unit MATERIALS

Materials engineering process refers to fabrication or modification of materials.
The aim is to obtain materials with specific structure, properties and performances depending on the application.
4,5 Full Time Employees

MOLECULAR BEAM EPITAXY

Molecular beam epitaxy (MBE) is a technique to growth crystalline overlayers and heterostructures on a crystalline substrate using atomic or molecular beams. These beams are produced by heating high purity solid source materials or by cracking very pure gases under ultra high vacuum, that then condensate on the substrate.

- Up to 3 inch wafer
- Around 200 epitaxial growths per year

- **Epitaxial growth of III-V semiconductors**

Solid source MBE characteristics

- RIBER COMPACT 21TM
- Effusion cells : Ga, Al, In, Si, GaTe
- Gas injectors : CBr_4
- Valved crackers : As, P, Sb
- Growth on 2 and 3 inch substrates
- RHEED up to 15 KV
- Temperature measurement by Band edge thermometry

Gas source MBE characteristics

- RIBER 32
- Effusion cells : Ga, Al, In, Si, Be
- Gas injectors : AsH_3, PH_3, CBr_4
- Valved crackers : Sb
- Growth on 2 and 3 inch substrates
- RHEED up to 35 KV
- Temperature measurement by band edge thermometry

- **Epitaxial growth of Graphene**
  - RIBER Compact 21
  - Carbon & silicon solid sources
  - H / H_2 source
  - Sample holder heating T ≤ 1500°C
  - In-situ characterisation by RHEED
  - Coupled under UHV with a surface analysis chamber equipped with LEED and Auger spectroscopy

ION IMPLANTATION

Ion implantation is a materials engineering process by which ions of a material are accelerated in an electrical field and impacted into a solid. This process is used to change the physical, chemical, or electrical properties of the solid.

- Production and R&D chambers
- More than 250 implantations per year
- Up to 4 inch wafer
- Principal implanted species: As, P, Si, He, Ar, N, C, B, F
- More than 30 species can be implanted

Implanter EATON-AXCELIS GA 3204

- Energy : from 5 keV to 200 keV
- Doze : from 1E11 at./cm²
- Sources: Gases, solid
- Tilt : 0° to 45°
- Twist : 0° to 360°
- Target carrier temperature: -10°C to +300°C

ANNEALSYS Rapid Thermal Annealing

- Temperature range: 100° to 1200°C
- Susceptors : Silicon or Graphite coated with SiC
- Operation : N_2, N_2H_2, High vacuum
- Up to 6 inches

SURFACE CHEMISTRY LABORATORY

This laboratory is dedicated to organic synthesis and purification of molecules designed for electronics. The principal activity of the lab concerns the surface functionalization by molecules for molecular electronics (molecular switches, diodes, memories, sensors...) or for nanobiotechnologies. The Self Assembled Monolayer technique (SAM) is also used to provide specific physico-chemical properties to various surfaces, such as wettability, encapsulation or chemical reactivity. Synthesis and grafting of nanoparticles (Au, PbSe) on different substrates are also realised.

Synthesis under inert atmosphere

- Nitrogen glove box
- Schlenkware
- Vacuum / nitrogen manifold

Purification of solvents and organics

- Kugelrohr ovens
- Flash Chromatography
- Distillation
- Rotavapor
- Centrifuge

ORGANIC PLATFORM

Associated with the laboratory of organic chemistry, the organic platform is dedicated to the preparation of molecular and organic devices. Two connected glove-boxes (M-Braun model, O_2 and H_2O level < 1 ppm) permit to deposit on a substrate various organic materials (self assembled monolayers by surface chemistry or polymers by spin coating) then other organics or metals can be evaporated on-line (by joule effect at 10^{-7} mbar) without any contact with atmosphere.

Vacuum / nitrogen manifold

In addition of usual organic chemistry glassware, the lab is equipped with specific apparatuses for manipulation under inert atmosphere (schlenkware, vacuum/N_2 manifolds, glove box). Solvents, chemicals or nanoparticles can be purified by various equipments (distillation apparatus, Kugelrohr oven, rotavapor, flash chromatography, centrifuge).

Rotavapor

Kugelrohr oven

Flash chromatography

DEPOSITION

Unit CHEMICAL VAPOR DEPOSITION

Chemical vapor deposition process refers to chemical and thermal processes used to deposit or grow high purity conformal thin layers with a good uniformity.
3 Full Time Employees

ATOMIC LAYER DEPOSITION

Atomic Layer Deposition (ALD) is an advanced thin film coating method which is used to fabricate ultrathin, highly uniform and conformal material layers.

- 2 process chambers
- 1 mono layer growth control
- Around 800 depositions per year
- 2 glove boxes (N, Ar)
- Up to 8 inch wafer

Al_2O_3, ZrO_2, HfO_2, TiO_2, Ta_2O_5, TiN, TaN, ZrN, HfN, Pt

TFS200 Beneq

- Flow through chamber
- Thermal or plasma enhanced reaction
- Capacitively coupled plasma, up to 300W (13,56 MHz)
- Pulsed or continuous.
- Chamber can be heated up to 500°C

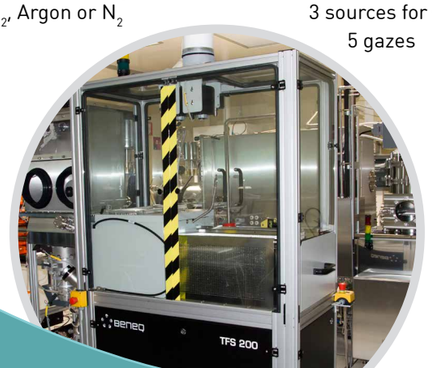
11 precursors available

- 3 non-heated canisters : H_2O, TMA, $TiCl_4$
- 4 heated canisters up to 300°C : $MeCpPtMe_3$, TEt_2NZr, TEMAHf, $TaCl_5$
- 4 gas lines: O_2, NH_3, H_2, Argon or N_2

ALD PICOSUN - R200 advanced

- Substrate Size
  up to 200 mm single wafers
  3D objects
  Through-porous and HAR samples
- Process temperature
  50-500°C
- Substrate loading options
  Pneumatic lift
  Load lock with magnetic manipulator arm
- Precursors
  Liquid, Solid, Gas, Ozone

2 liquid sources
3 sources for solid
5 gazes



AP-CVD and LP-CVD

APCVD (Atmospheric Pressure Chemical Vapor Deposition) and LPCVD (Low Pressure Chemical Vapor Deposition) refer to chemical and thermal processes used to deposit high purity thin layers with a good uniformity.

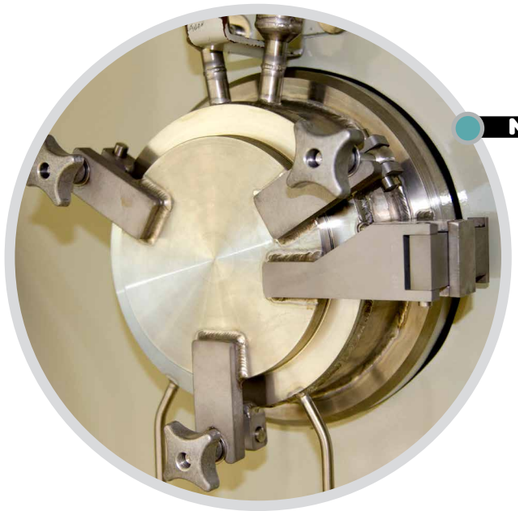
- Up to 4 inch wafer
- 5 process tubes

2 APCVD Tempress Furnaces

- 2 APCVD tubes for thermal oxidations of silicon wafers up to 1100°C with O_2 gas (dry oxidation) or H_2O vapor (wet oxidation) at atmospheric pressure.
- Thickness: from 2 nm up to 1.5 µm
- Applications: insulation, passivation, smoothing of side effects after plasma etching

3 dedicated LPCVD tubes (dry pumps)

- Polycristalline silicon (≤ 600°C) and in-situ phosphorus doped polysilicon (650 to 750°C)
  - thickness up to 2 µm
- Low Temperature Oxide (SiO_2 deposition at 420°C), boro- (BSGLTO), phospho- (PSGLTO) or BoroPhosphoSilicate Glass (BPSGLTO)
  - thickness up to 5 µm
- Low stress (Si_xN_y) or stoichiometric (Si_3N_4) silicon nitride , 800°C
  - thickness up to 1 µm
- **Applications** → insulation, passivation, p-n junction
- Gas: O_2, H_2, SiH_4, PH_3, BCl_3, SiH_2Cl_2, NH_3, N_2, Ar



MPA INDUSTRIE REACTOR

It is a LPCVD furnace dedicated to Si, Ge nanowire growth. A metal catalyst (typically Au) on the substrate promotes nanowire growth.

- 3 types of tubes:
  - Quartz until 1100°C
  - Alumine until 1400°C
  - Pyrex until 550° C
- Gas:
  - SiH_4
  - PH_3/H_2
  - C_2H_4
  - N_2
  - H_2/Ar
  - B_2H_6/Ar
  - GeH_4

DEPOSITION

Unit CHEMICAL VAPOR DEPOSITION

PARYLENE COMELEC C20S

Parylene thin film : COMELEC C20S

Parylene is the trade name for a variety of chemical vapor deposited poly(p-xylylene) polymers.
Parylene C, D, N available,
Parylene C being the most used (combination of barrier properties, cost, and processing advantages).
Room temperature depositions on a wide range of materials and shapes
Thickness ranging from 30 nm to 100 µm
Surface preparation for adhesion enhancement on demand

Room temperature deposition (3 steps):

- Vaporisation of the solid dimer
- Pyrolysis of the dimer to yield the monomeric diradical
- Simultaneous adsorption and polymerisation of the monomer on the substrate (at RT)

Characteristics of Parylene

- Excellent electrical insulator
- Biostable and biocompatible coating
- Highly conformal coating, homogeneous surface
- Very low permeability to gases
- Highly resistant to chemicals

Potential applications and fields of interests →

- Device encapsulation/ Surface passivation / environmental protection
- Dielectric layers/ Electrical insulation
- Hydrophobic/ Superhydrophobic coating
- Shadow masks/ flexible substrates
- Bonding layers

GRAPHENE

Graphene is a two dimensional carbon allotrope with a honeycomb structure. It is known to be a very light and strong material. It has excellent thermal, mechanical, optical and electrical properties. CVD is an inexpensive technique to produce large area graphene. It is done on metal substrates/layers where hydrocarbon precursors decompose and form graphene.

JETFIRST 100F Rapid Thermal Processor

- Materials: Cu, Ni foils or / and thin films
- Graphene growth in Ar / H_2 / CH_4, rapid heating and cooling ramps.
- Typical conditions on Cu : 980°C - 1050°C (10-100 sccm Ar, 1-200 sccm H2, 1-20 sccm CH_4, 10-20 Torr)

Growth of monolayers, multilayers, hexagonal domains
Up to 4cm² homogeneous graphene sheets optimized growth
Transfer technique by removal of the catalytic substrate and sticking on a large set of substrates (components, flexible).

Potential applications and fields of interests →

- Flexible and transparent conductors
- Optical electronics
- Bioengineering
- Energy technology and storage
- Components
- Sensors
- Composite materials

PLASMA-ENHANCED CVD

Plasma-Enhanced Chemical Vapor Deposition is a process used to deposit thin films from a gas state to a solid state on a substrate.

Oxford Plasmalab 80 plus

Film stress can be controlled by high / low frequency mixing techniques to deposit silicon nitride, silicon dioxide and silicon oxinitride

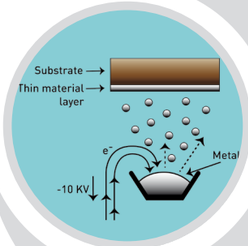
- HF 13.56MHz and BF 50 to 400KHz
- Gases: SiH_4 5% in N_2 - NH_3 - N_2O - N_2 - He and CF_4 with 20% O_2 - O_2
- Deposition temperature: between 100 to 340°C
- Deposition rate: between 100 to 700 Å/mn

DEPOSITION

Unit PHYSICAL VAPOR DEPOSITION

Physical vapor deposition is a vaporisation or condensation coating technique, involving transfer of solid materials onto a substrate. 2,5 Full Time Employees

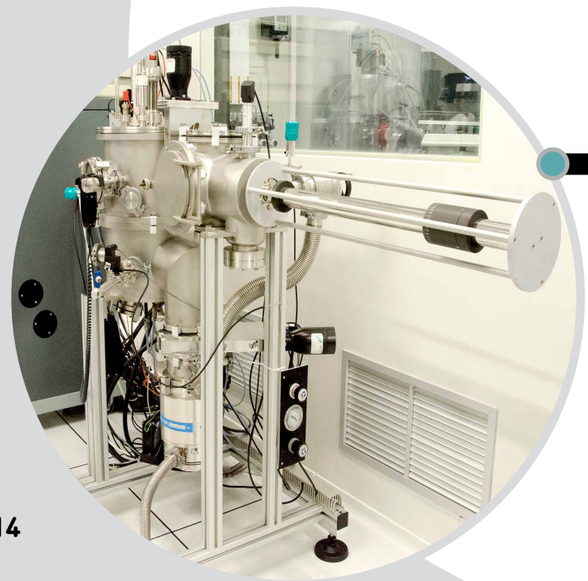
The heat is provided either by joule heeting via a refractory metal element (resistive evaporation) or directly from a focused beam of high energy electrons (electron beam evaporation). More than 3000 depositions per year (Metal, Dielectric material, Magnetic layer)



ELECTRON BEAM

• 2 PLASSYS MEB 550S
- Load lock with substrate treatment (ion beam source 3cm)
- Capacity : 4 substrate holder 4 ''
- Materials: Au, Ti, Ge, Al, Pt, Ni, Mo, Cr, Pd, Ag....

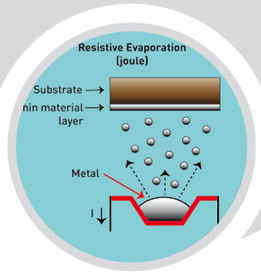
• 1 Siliciuration MECA 2000
- Load lock with substrate treatment (ion beam source 3cm)
- Tilt table substrate holder with planetary rotation.
- Backing chamber UHV (T°max:750°c)
- Materials: Ti, Ge, Pt, Er, Yb, W.
- nMOS and pMOS ohmic contacts realisation SOI substrate and Bulk Type n: Er/Yb ; type p : Ge/Pt, Pt, Ir. Metal Gate : W, Ti



RESISTIVE (JOULE)

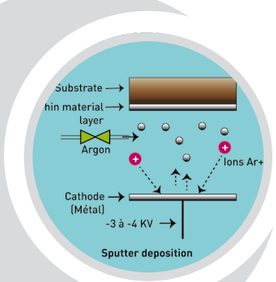
• APRIMVIDE
- Substrate temperature up to 400°c
- 3'' Capacity
- Deposition: Ca, Al, Au..., Organic layers: (Pentacene, sexithiophène,triphenyl diamine)

• 1PLASSYS MEB 450S
- Load lock with substrate treatment (ion beam source 3cm)
- Capacity : 1 substrate holder 4 ''
- 3 sources: In, Cr, Au
- Substrate holder with planetary rotation



SPUTTERING SYSTEMS

The sputtering method involves ejecting material from a "target" onto a substrate by sending ions to the target.
- Up to 4" wafer
- 6 deposition process chambers



• 2 ALLIANCE CONCEPT DP650
Cold or heated (750°c) substrate holder

• DP 650n°24
- 4 cathodes 6''
- Powered with 1DC and 1RF source
- Deposited materials : Au, Al, Ti, Cr

• DP 650n°34
- 6 DC and RF cathodes 4''
- Powered with 1 DC pulse, 1DC and 1RF source
- Deposited materials : W, Cu, TiN, TiNi, TiW, Ni, ...

• 1 LEYBOLD Z550
- 1 cathode 6 " and 4 cathodes 4" RF and DC
- Magnetic layer deposition
- TbFe2, TbCo2, TbFeCo, FeCo, Fe, Co, CoPt, FePt, Ta, Cr

• 1 ALLIANCE CONCEPT CT 200 CLUSTER
- 14 targets, 3 chambers, fully automated sputtering cluster
- **Applications** → single or multi-layers processes, reactive sputtering , co-sputtering
- Realisation of complex structures without vaccum break and cross-contamination of chambers

CHARACTERISTICS	Chamber 1 Magnetic Multilayers/Metals	Chamber 2 - Alloys (AlN, ZnO, MgO, ITO...), LiPON, photovoltaic materials	Chamber 3 - thermoelectric materials (Boron Carbides)
	• 6 x 2'' magnetron targets • Confocal sputtering • 2 DC-pulse source and 2-RF sources • Cold or heated (400°C) substrate with rotation for uniformity over 4" • Reactive sputtering of nitrides also allowed.	• 4x 4'' (3'' also available) targets in planar mode • 1 DC and 1 RF power source. • Cold or Heated (800°C) substrate holder	• 3x 2'' magnetron targets in confocal mode + 1x 4'' magnetron target in planar mode. • 1 DC pulse, 1 DC and 1 RF source • Heated (400°C) substrate holder • Rotation for uniformity over 4"

DEPOSITION Unit

ELECTROPLATING

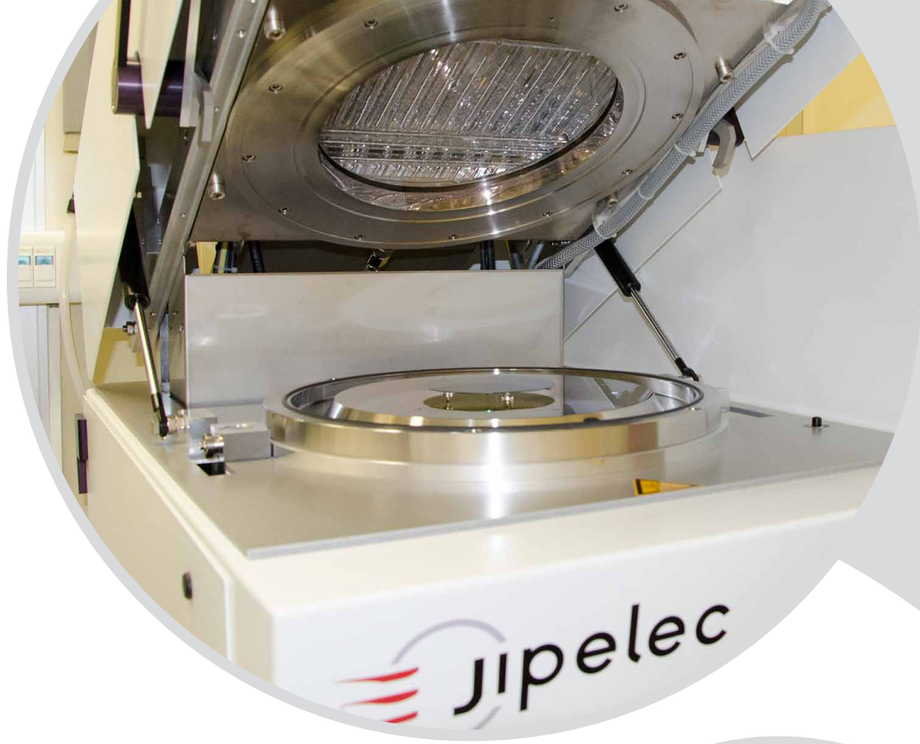
Electroplating is a process that uses electrical current to reduce dissolved metal cations so they form a coherent metal coating on an electrode. More adapted to thick layers.

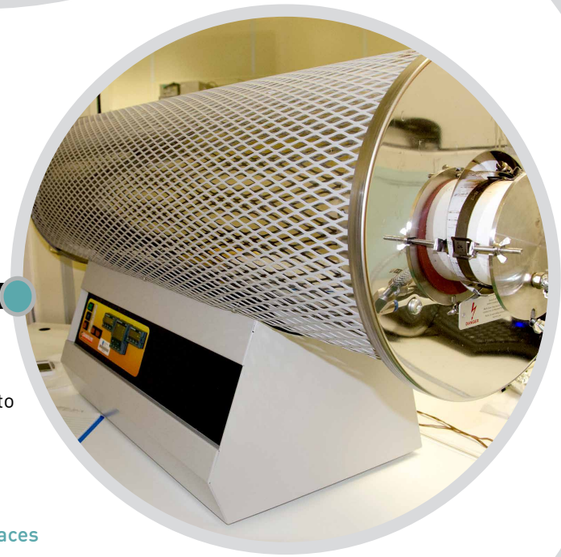
Rena Electroplating

- 2 A DC current for gold deposition
- 5 A AC pulsed current for copper deposition

Applications →

- Current redistribution layers for opto- and microelectronics
- Solder, Cu and Au bumps for wafer level packaging (WLP)
- Functional metallic layers for micro - electro - mechanical systems (MEMS)
- Micro forming and molding for microsystems





FURNACES

Rapid Wafer Heating System
JIPELEC JETFIRST 200

- Range of temperatures : 100°C - superior to 1000°C
- Samples to 8''
- Gas process : N_2 - N_2/5%H_2 - O_2

2 Atmospheric Pressure Tubular Annealing Furnaces
CARBOLITE and VASSE

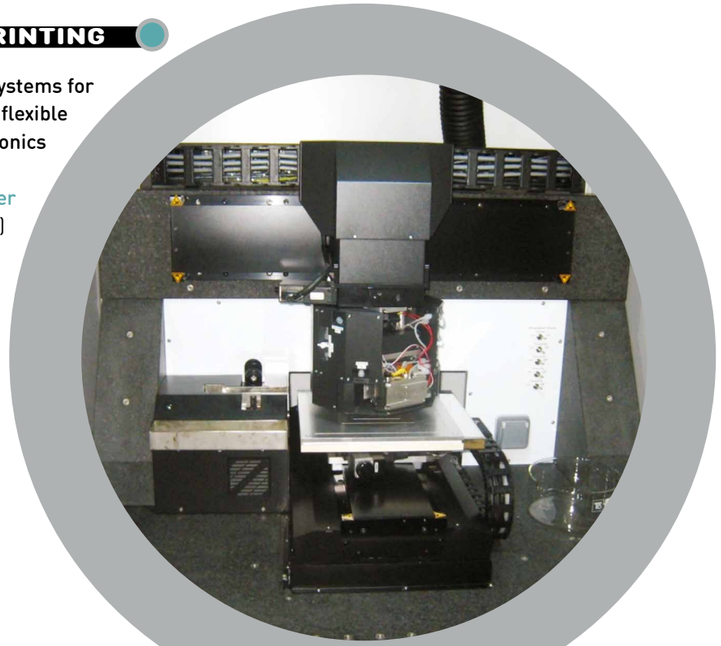
- Range of temperatures : from 100°C to 1000°C
- Samples to 3''
- Gas process : N_2;N_2/5%H_2

INKJET PRINTING

Powerfull digital materials deposition systems for printing of functional materials: printing on flexible substrates and printed electronics

Ceradrop X-Series Inkjet printer

- 2 Dimatix Printhead (128 Nozzles each) Diameter of nozzles 35 µm
- 1 Mono nozzle printhead Diameter of Nozzle 20 µm, 30 µm or 35 µm
- 1 IR Dryer
- Printing of silver nanoparticles ink, polymer solutions, dielectric ink and carbon ink



LITHOGRAPHY

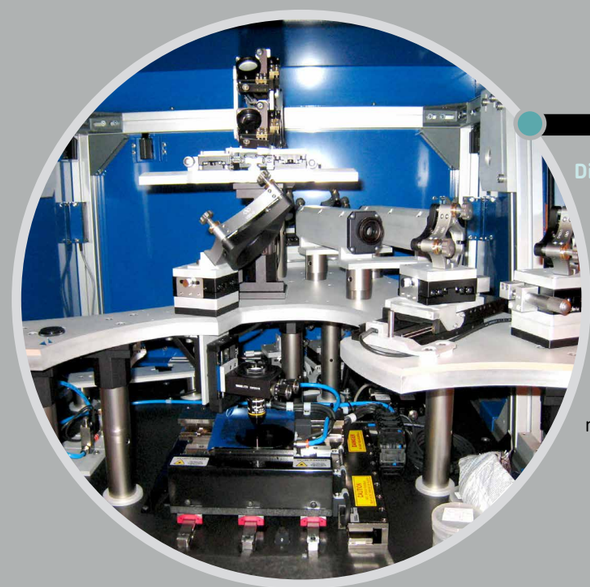
Unit OPTICAL

Lithography process gives the capability of patterning materials at micro and nanometer dimensions. It uses radiation (UV light or electrons) to pattern sensitive optical and ebeam resists.
4 Full Time Employees

OPTICAL LITHOGRAPHY

The optical lithography division gives the capability of patterning materials at micro and submicrometer dimensions. It uses light to transfer a pattern from a photomask to a light-sensitive chemical photoresist on the substrate.

- From ¼" to 4 inch wafer
- More than 30 photoresists available
- Optical resists: SU8 - 2000, AZ series, SPR series, PMGI-LOR-UV210, PDMS, BCB dry etch, BCB photosensible

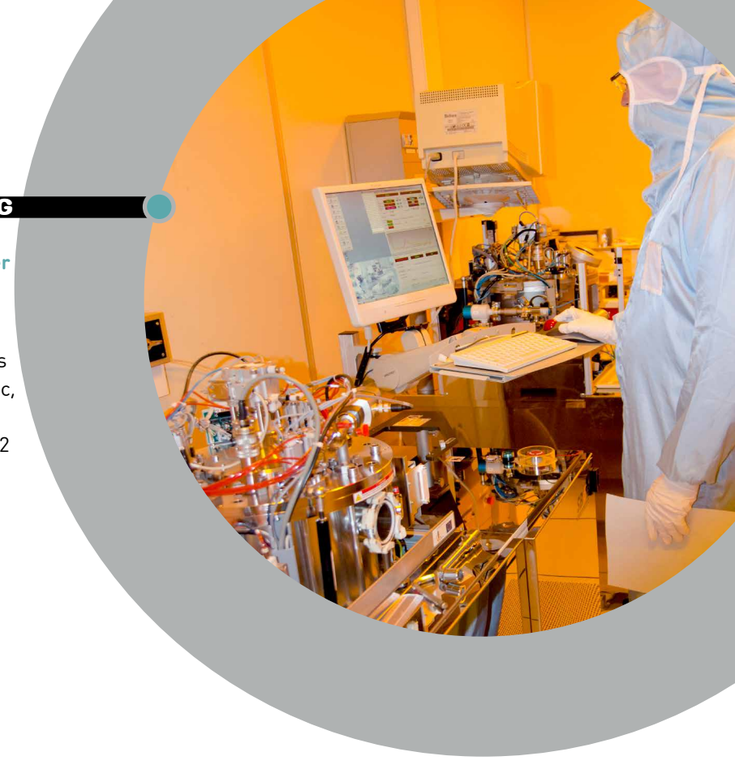


LITHO LASER 2D

Dilase 650 Kloé

High Resolution Direct Lithography System for fast Prototyping and Maskless Fabrication

- Laser source 375 nm, 73 mW
- Wafer writing area 100 x 100 mm
- Laser spot size: 1µm and 10 µm
- Stage travel resolution and repeatability: 100 nm



WAFER BONDING

1 Suss MicroTec SB6e Wafer Bonder in combination with MA/BA6 Mask Aligner

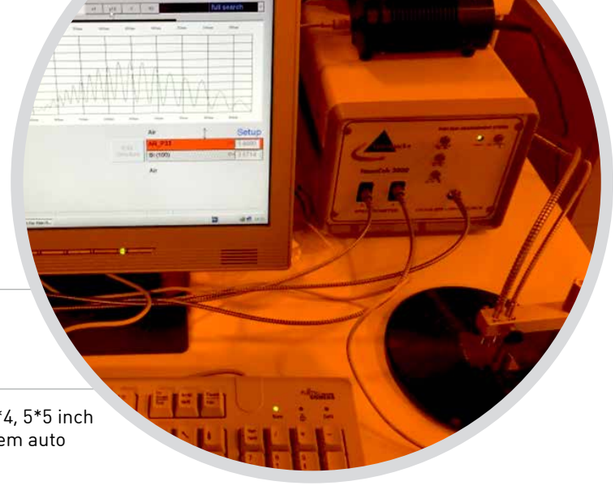
- For aligned and unaligned wafers using thermo-compression, anodic, fusion, adhesive, etc
- Wafer size: pieces smaller than 2 inch, up to 4 inch
- Aligned bonding: down to 3 µm depending on process conditions

MASK ALIGNERS

2 Suss MicroTec MA6/BA6 Mask Aligner and Bond Aligner UV 240-365 nm

- Wafer size from ¼ to 4 inch and mask size: quartz 4*4 and 5*5
- Exposure mode: Proximity, soft, hard and vacuum contact
- Top side alignment (TSA) down to 0.5µm, bottom side alignment (BSA) down to 1 µm
- Resolution with vacuum contact down to 800 nm with resist Aznlof 2020

Unit LITHOGRAPHY



EQUIPMENTS	CHARACTERISTICS
NanoCalc Thin Film Reflectometry System	• NanoCalc UV2000 / UV / NIR • The NanoCalc-2000 can be used to measure the film thickness from 10 nm up to 250 µm
6 Gyrset RC8 and RCD8 spin coater	• Wafer size from 3x3 mm to 4 inch and optical mask 4*4, 5*5 inch • System (EBR) edge bead remover for wafers and system auto cleaning with specific solvent
5 SSE Hotplate	• Controlled process with nitrogen until 300°C : uniformity 0.1°C • Programmable with lift pins • HMDS vapor prime
2 Sawatec Hotplate	• Controlled process with nitrogen until 300°C uniformity 0.1°C • Programmable with lift pins • Controlled ramp up, steps, dwell, and ramp down • HMDS vapor prime • Controlled process with nitrogen and vaccum

ELECTRON BEAM LITHOGRAPHY

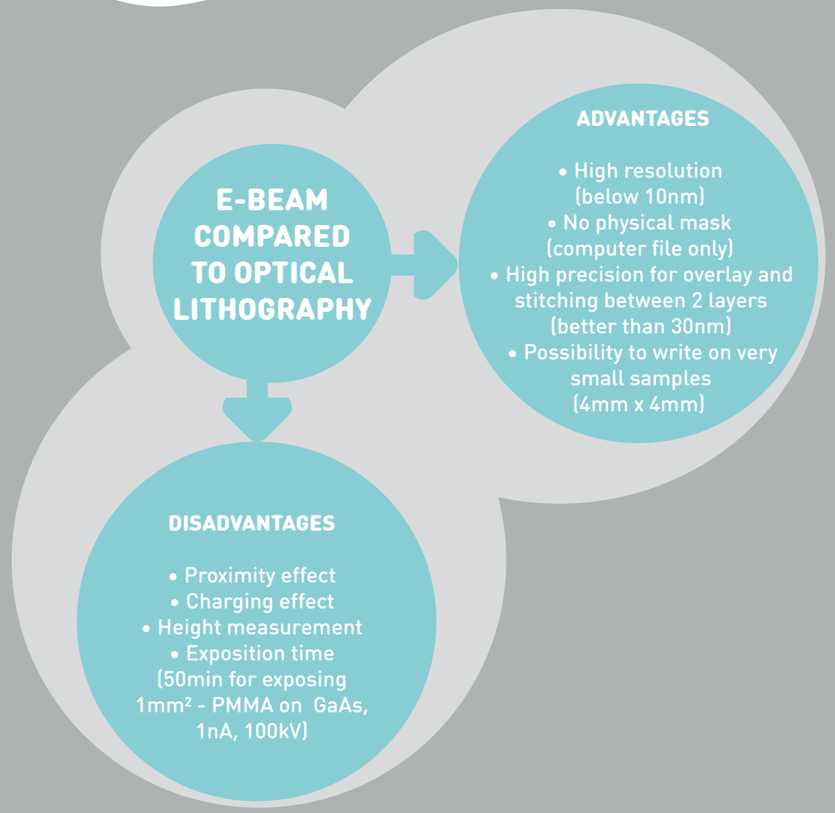
E-beam lithography is a lithographic process that uses a focus beam of electrons to define in an electron-sensitive resist custom patterns. The solubility of this resist is changed by the electron beam. Therefore, there is a selective removal of the resist by immersing it in a solvent (development).

Two beam writers EBPG 5000 plus

- More than 2000 writings per year
- From small sample (4mm x 4mm) up to 4 inch wafer
- E-beam resists: - PMMA, COPO, UV210, HSQ, SAL601, AZnLof...

EBPG 5000 Plus

- High Resolution Gaussian Beam System
- Thermal Field Emission Gun
- 50MHz Pattern Generator
- Minimum address grid 0.08 nm
- Maximum field size : 524 µm (DAC 20 bits)
- Interferometer stage, 0.6 nm positioning accuracy
- Acceleration voltage: 20kV, 50kV or 100kV
- Automatic 10 positions airlock
- Holders for 2" to 4" wafers , 3" to 5"masks and smaller piece parts
- Overlay and stitching better than 30 nm



Unit ETCHING
PLASMA

Etching is used in microe-lectronics to chemically or/and physically remove layers from the surface of a wafer during process. For many etching steps, part of the wafer is protected from the etchant by a «masking» material which resists etching.
1,5 Full Time Employees

REACTIVE ION ETCHING (RIE)

Reactive Ion Etching (RIE) uses chemically reactive plasma and physical sputtering to remove material deposited on wafers.

• 2 systems OXFORD Plasmalab 80plus
- Single 600W RF plasma source determines both ion density and ion energy
- Ion energy dependent on the RF power and process pressure
- Negative self-bias forms at the substrate electrode
- Gas : O_2, CF_4, CHF_3, SF_6, He, Ar, H_2, O_2, N_2
- Laser interferometry endpoint detection systems

INDUCTIVELY COUPLED PLASMA (ICP - RIE)

ICP source produces a high density of reactive species. Separate RF generators for ICP and electrode provide separate control over ion energy and ion density often achieving higher etch rate and lower damage. High process flexibility, can also be run in RIE mode for certain low etch rate applications. Materials etched are III-Vs, silicon, silicon oxides, several metals, glass,...
All of our etching chambers are equipped with laser interferometry endpoint detection systems.

• OXFORD Plasmalab System 100 dual chamber cluster ICP 180
Two process chambers
- Gas chamber 1 : CH_4, H_2, Cl_2, O_2, SF_6, Ar
- Gas chamber 2 : Cl_2, BCl_3, O_2, SF_6, Ar
- The system includes wafer clamping and helium cooling, providing temperature control (range 5°C to 60°C)

• SENTECH SI 500:
- Gas: CH_4, H_2, Cl_2, O_2, SF_6, Ar, Cl_2, BCl_3, HBr
- Providing temperature control (range -20°C to 250°C)
- For up to 200 mm wafers

DEEP SILICON ETCHING

Bosch process
The Bosch process is two steps process. It enables highly anisotropic deep silicon etching. It uses fluorine based plasma chemistry (SF_6), to etch the silicon combined with a fluorocarbon (C_4F_8) plasma process to provide sidewall passivation and improved selectivity to masking materials. A complete etch process cycles between etch and deposition steps many times to achieve deep, vertical etch profiles.

2 bosch process based reactors:
• STS
• Oxford estrelas plasmapro100 with cryogenic capabilities:
Estrelas is equiped with a cryogenic electrode, that allows to do Si etching at very low temperature (-150°C min. Typically at -120°C / -90°C). No passivation steps or needed at low temperature to obtain anisotropic etching and at the same time it allows to obtain very smooth walls, which is very interesting for optoelectronics applications.
- Etch depth: wafer through
- Selectivity to PR > 250:1
- Selectivity to SiO_2 > 500:1
- Uniformity <± 3%

ION BEAM ETCHING (IBE)

No chemical reaction:
- **Only sputtering with an argon ion beam**
- **Highly anisotropic etching**
- **Poor selectivity**

• PLASSYS MU350 system
- Filamentless, Radio Frequence driven and low pressure plasma beam source, 160mm diameter
- Mainly used to sputter metals

SURFACE CLEANING AND TREATMENT

• Plasma system PVA Tepla 300 semi-auto
Microwave plasma stripper
Dry process for photoresist stripping and substrate cleaning
Microwave plasma produces a very high concentration of chemically active species with low ion bombardment energy guaranteeing fast ash rate and a damage-free plasma
Tubular quartz chamber with 1000W microwave generator
Option : Faraday cage to reduce electro static discharge (ESD)
Gas : O2, Ar, CF4
• Pico : Surface cleaning by O_2, Ar plasma

ETCHING

Unit CHEMICAL

WET ETCHING

Wet etching is an etching process that uses liquid chemicals to remove materials from a wafer. Chemistry stations:

- Organic, halogeneous, inorganic acids
- Inorganic bases
- Halogeneous and non halogeneous solvents

TREATMENT AFTER WET ETCHING

Critical Point Dryer SCFluids (CPD1100)

The Supercritical CO_2 Dryer uses liquid and supercritical carbon dioxide to dry MEMS wafers efficiently and with high yield. Due to zero surface tension in the supercritical state of the CO_2, stiction, a most critical negative yield factor is avoided completely.

The standard used conditions are 76 bar and 40°C

Basic Characteristics:

Wafer max size : 6 inches
Wafer max thickness : 5 mm
Max pressure : 110 bar
Max temperature : 65 °C

WET ETCHING COMPARED TO DRY ETCHING

DRY ETCHING:

- Good Anisotropy
- To achieve small features
- High cost

WET ETCHING:

- Low cost, easy to operate
- Good selectivity for most materials
- Isotropic
- sensitive to changes in temperature

XeF2 ETCHING SYSTEM

The Xactix® X4 SeriesTM is the XeF_2 etch system for releasing Silicon based MEMS devices.
It uses cyclic vapor exposition to isotropically dry etch sacrificial silicon:
- high rate silicon etching system with
- high silicon /silicon oxide selectivity

VAPOUR HF ETCHING SYSTEM

The fabrication process of MEMS devices in silicon microtechnologies involves as final step the releasing of the microstructures by an etching of a silicon dioxide sacrificial layer. The "vapour HF" technique gives access to a releasing process which is an alternative to the one including wet HF etching + CO_2 supercritical drying. Advantages of the "Vapour HF" technique are manifold, and come from the dry and anhydrous conditions the "Vapour HF" machine brings: stiction free releasing, carbon free surfaces, selectivity versus metals and silicon nitride.

The SPTS "uEtch" is a single-wafer system. Wafers from pieces to 8 inch can be loaded in the chamber. Using 5 different recipes calibrated on the machine, we are able to etch TOX with an etch rate of 100 Å/min to 1650 Å/min and a uniformity around 2% on 3 inch.

INTEGRATION

Unit BACK END

Back end process refers to the process done outside cleanroom at chip level from wafer backgrinding to packaging.
3 Full Time Employee

LAPPING, POLISHING

for a slow lapping and a soft polishing
A plate in rotation carries a cloth impregnated of an abrasive micro suspension. The sample, laid out on a head in rotation and translation, is brought to the contact with a controlled pressure.

PM5 (LOGITECH)

Main Characteristics:

- Materials: III-V Materials (InP, AsGa), Si, Lithium Niobate ...
- Up to 4'' wafers and small pieces
- Sample maximum thickness: 2 mm
- Plate speed: 0-70 rpm
- Applied pressure: 0 to 2 kg
- Removed material mesured by a dial gauge - 1 to 5 µm/min
- Autofeed system
- Automatic lapping plate flatness control
- Thickness resolution : +/- 5 µm
- Roughness of the order of nm

Applications →

- Preparing the surface prior to fabrication,
- Thinning the device after fabrication,
- Providing defect free face polishing on substrate.

Wafer Substrate Bonding Machine (LOGITECH)

- Up to 4'' wafers and small pieces
- Automated process cycle
- Excellent wafer to support disc parallelism
- Process repeatability

MEGASONIC CLEANING SYSTEM

The principle of the lapping or polishing machines is to remove materials with abrasive slurries. At the end of these operations and in spite of a rinsing step, the surfaces of the samples are contaminated by particles from slurries.
The Polos Spin-Meg Pie is dedicated for the cleaning of substrates, especially for the silicon wafers after CMP process. A spinner with a megasonic transducer composes it. The suitable wafer size is 3 or 4 inches. The standard fluid is desionized water but chemistry can be used also for a better decontamination.

CMP

E 460 (ALPSITEC)

CMP: for a soft and precise polishing and planarisation process
Chemical mechanical planarization is a process of smoothing and planing surfaces with the combination of chemical and mechanical forces, in order to prepare them for the following steps.
The CMP tool consists of a rotating platen, covered by a pad. The wafer is mounted upside down in carrier. The platen and the carrier are rotating. Pressure is applied by down force on the carrier.
A slurry is supplied from above on the platen.

Main characteristics:

- Authorized substrates: from 2 to 4 inches, possibility to work with small sized-samples
- Substrate rotation speed: 5-130 rpm
- Plate rotation speed: 5-120 rpm
- Applied pressure: 0-950 mdaN/cm2
- 10 steps per recipe
- 4 slurries possible during the process
- Materiels: Si, poly Si, SiO_2, metals (Cu, W...)
- Maximum removed thickness: 20 µm

Applications →

- Interlevels dielectrics ILDs
- Shallow trench isolation STI technology
- Damascene process

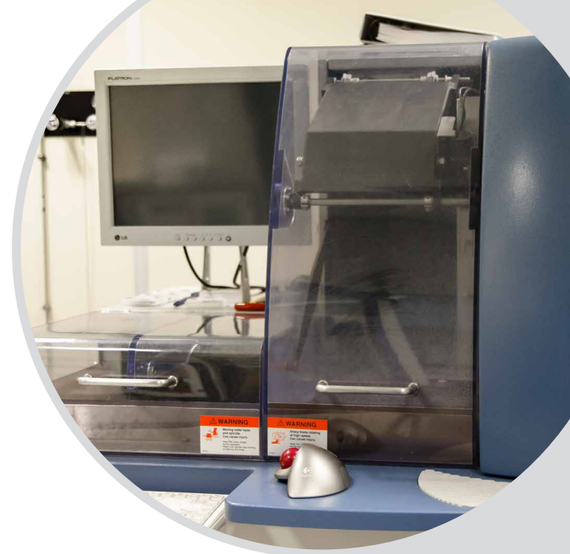
GRINDER

MPS 2 R300 (G&N)

For a fast and agressive mechanical thinning of substrates
A rotation abrasive wheel removes the material on a sample itself in rotation.
Main characteristics:

- Substrate: from 2 to 8 inches
- Five 4 inches substrates max
- Substrate rotation speed: 0-30 rpm
- Head max rotation speed: 2600 rpm
- Height precision: 3 µm
- Grinding speed: 1-30 µm
- Materials: Silicon

Ultra pure deionized water allows cooling during the process.

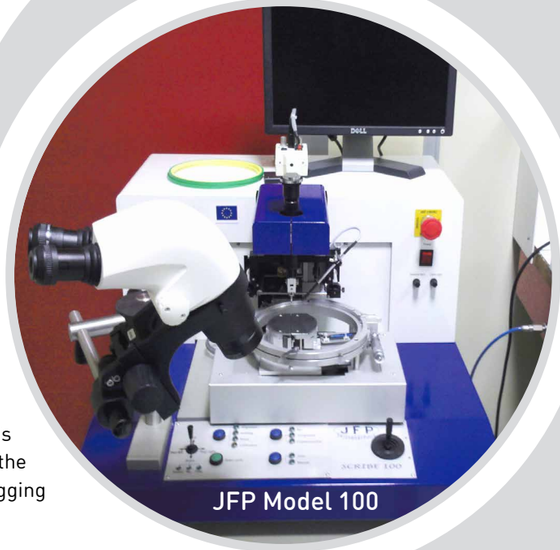


WAFER SCRIBER/BREAKER

Wafer Scriber/Breaker: **Realisation of a seed in a preferred crystallographic direction to force the cleavage**

The scriber is a machine designed scribing & breaking of delicate die, such III-V materials & silicon chip. It keeps the finished die clean and damage-free.

After positioning the substrate on the Mylar film, it aligns the diamond tip on the cutting or along the desired axis lines. Then, it strongly supports the diamond peak on the surface by dragging the substrate to create a fracture line.


JFP Model 100

Main characteristics:

- Diamond peak
- Substrate up to 4 inches
- Materials type: Si, AsGa, InP
- Resolution of position: 1 µm
- Vision system allowing a programmable or manual alignment
- Break mode: operator control or automatic
- Scribing length programmable and scribing repeatable
- Robust, vibration free, requiring minimal training to operate

DRY FILM LAMINATOR

This equipment is suitable for the application of dry film resist containing a very thin temperature and/or pressure sensitive adhesive layer.

Bungard RLM419P

- Sample size: up to 400mm large and up to 8mm thick
- Hot rolls digitally controlled in the 20-200°C temperature range
- Pressure adjustable through the control of the edge gap between rolls

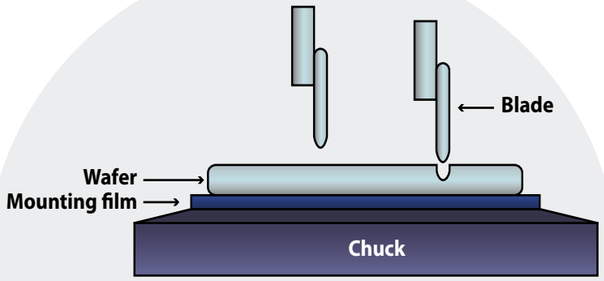
DICING SAW

Diamond saw for substrates dicing, components individualisation

The substrate to be diced is positionned on a flexible adhesive film and fixed on the chuck. After alignment between the cutting ways on the substrate and the blade, the substrate moves at a selected speed under the blade. The blade is cooled by water jet and its rotation speed is controlled. Dicing can be made in manual or automatic ways.

Main characteristics:

- Rotation speed of the blade: 0 – 60000 rpm
- Chuck displacement speed: 0.5 à 200 mm/s
- Substrates size: up to 8 inches max
- Materials: III-V materials, silicon, glass, ceramics
- Optical alignnment of the blade



WIRE BONDING


K&S 4526
(Kulicke & Soffa)

Wire Bonding: Realisation of electric connections between the component and its support

Wire bonding is a method to make interconnections between a semiconductor device and its packaging during semiconductor device fabrication. A conductor wire is positionned using a specific tool (ball or wedge) to the top of the metal pad of the component contact. A welding is created by the application of force and ultrasounds. An heating effect can be added according to the nature of wire.

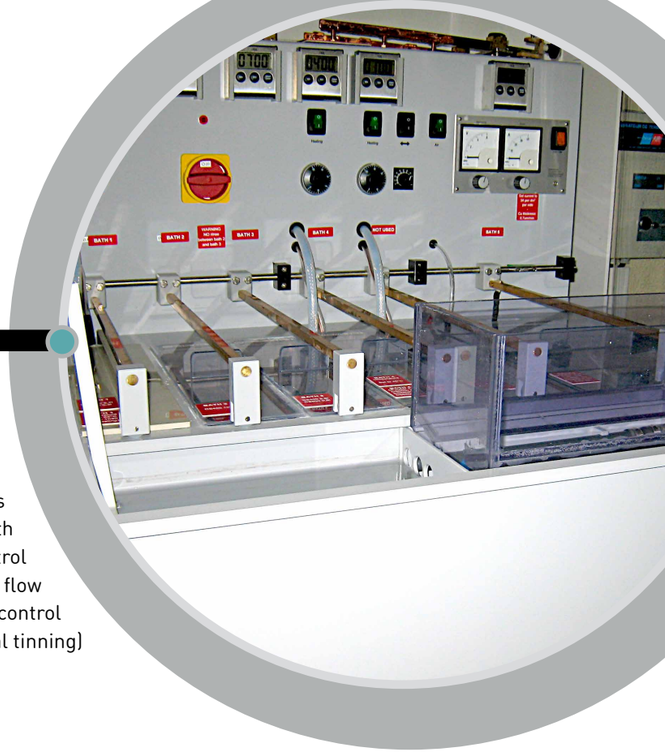
Main characteristics:

- Wire types: Au, Al
- Wire diameters: 12 to 76 microns
- Principle: ultrasonic and thermosonic

Technical characteristics of the WB100:

- Wedge, ball, bump bonder
- Bond force: 15 - 100 cNm
- Bond time: 15 - 5000 ms
- Gold wire diameter: 17µm to 50 µm
- Motorized Z travel: 20 mm
- Throat depth: 165 mm.
- Fitted with a heated work holder, a motorized wire spool, and a digital position pattern generator coupled with a video cam

Through-hole Copper Plating Line



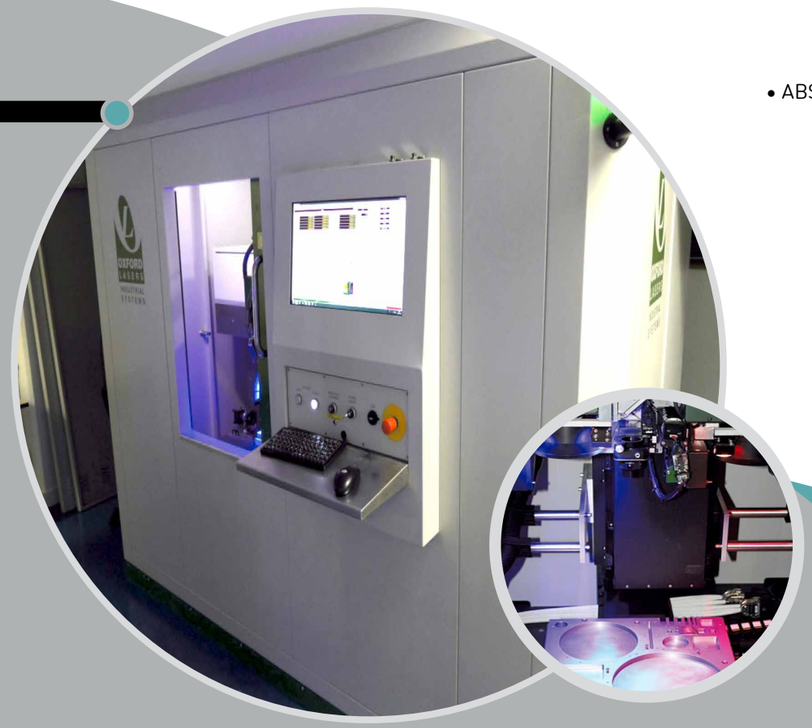
Bungard compacta 30 ABC

For laboratory prototyping of through-hole plated PCBs up to 210 x 300 mm size.
Clean system including built-in rinsing compartment.

- 5 treatment tanks, 2 of them with heaters
- 1 galvanic copper bath
- 1 triple-cascade rinse with flow control
- 1 spray rinse tank with magnetic valve, foot switch and flow control
- 1 free tank (i.e. for chemical tinning)

LASER ABLATION

Laser micromachining is emerging as a key technology for structuring, ablating, scribing, cutting, drilling a wide range of materials as diverse as semiconductor crystals, metals and plastics. Ablation selectivity betwen materials can be achieved with a proper selection of wavelength, laser shot repetition rate and beam velocity. Two laser micromachining equipments are available, operating in the nanosecond and femtosecond pulse regimes, respectively.



Oxford Laser Equipment #1

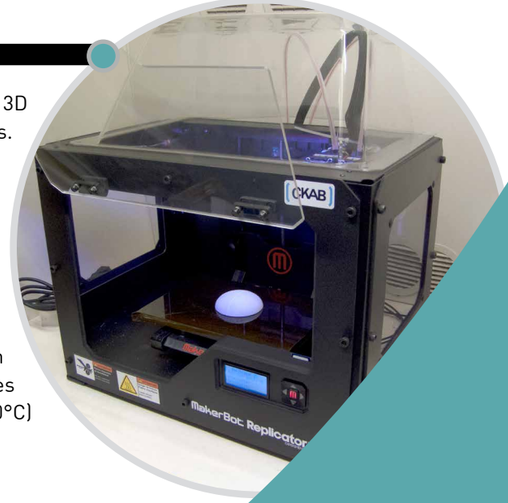
- Multi-wavelength femtosecond (300fs) diode-pumped (DPSS) lasers source (UV343,GR515,IR1030nm)
- Average power up to 20W and pulse energy up to 100 µJoule in IR
- Repetition rate up to 2MHz

Oxford Laser Equipment #2

- UV nanosecond (35ns) diode-pumped (DPSS) lasers source (351 nm)
- Average power up to 8W and pulse energy up to 5 mJoule
- galvanometer deflection with extended field of 50×50mm^2
- sample stage up to 300×300 mm^2

3D PRINTER

The dual-extruder MakerBot's Replicator 2X 3D printer produces good-quality objects.



MakerBot Replicator 2X

- Two extruders
- ABS, PETT, HIPS (dissolvable) filaments
- 100 µm layer resolution
- SD card / USB
- User-friendly software
- LCD navigation screen
- Various print modes
- Heated platform (110°C – 120°C)

CHARACTERISATION

Unit BEAMS

Characterisation process refers to in-line inspection for process control and materials study. A wide range of techniques are available from optical, electrical, physical or mechanical.
3,5 Full Time Employees

PHYSICAL CHARACTERISATION

PANalytical X'Pert Pro MRD
TA-DA XRD (Triple and Double-Axis X-Ray Diffraction)
X-ray Diffraction is a tool used for determining the crystalline structure of solids, in which the periodic atomic arrangement causes a beam of X-rays to diffract into many specific directions. The structure is determined by measuring the angle and intensities of these diffraction peaks.

Applications →
- Alloy composition and thickness
- Control of lattice matching of epitaxial layers layers with the substrate
- Interface quality of superlattices
- Thin strained layers
- Relaxation rate, composition and tilt of mismatched layers

ESCA (Electron Spectroscopy for Chemical Analysis)
X-ray photoelectron spectroscopy (XPS) is a surface-sensitive quantitative spectroscopic technique. Based on the photoelectric effect, it allows determining the elemental composition at the parts per thousand range and the chemical state of the elements present within a material.

- Monochromatized XPS with ultimate resolution: 0.45eV
- UPS: HeI and He II excitations
- Low Energy Electron Diffractometer (LEED)

Applications →
- III-V MBE grown surfaces and interfaces
- Graphene
- Organic layers
- Characterization of process steps

FOCUSED ION BEAM

Dual beam system combines a high resolution secondary electron microscope (SEM) and a focus ion beam with gallium metal ion beam source (FIB) for nanoscale machining, patterning, and nanomaterials characterization.
Materials can be milled or deposited while observing the evolution of the surface topography with secondary electrons (SEM or FIB).

FEI Strata DB235
Stage: 5-axis eucentric, all motorized stage

- **Ionic column**
  -Emitter (Gallium LMIS)
  - Acceleration Voltage (5kV - 30kV)
  - Probe Current (1pA - 20nA)
  - Image Resolution (7nm)

- **Electronic column**
  - Emitter (Field effect gun (Schottky))
  - Acceleration Voltage (200V - 30kV)
  - Resolutions (SEM: 3nm and STEM: 2nm)

- **Detectors :**
CDEM, SED, in-lens, STEM

- **Gas Injection System :**
Platinum, Tungsten and Carbon

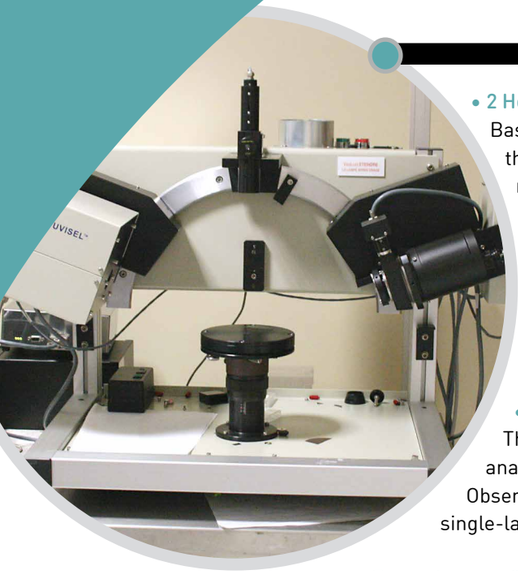
SEM

SEM (Scanning Electron Microscope) is a microscope that uses an electron beam to illuminate a specimen and produce a magnified image with a 1000 times higher resolution than optical light microscope.

Equipments
- ZEISS ULTRA 55 / EDS Bruker
- ZEISS SUPRA 55 VP / EBSD Oxford

- Maximum resolution : Close to 1nm @ 15kv
  Close to 3 nm @ 1kv
- Source type: Field effect gun
- Detector type: Inlens, Secondary and backscattered electrons
- Analysis: Chemical by EDS and Crystallographic by EBSD
- Wafer size: up to 6 inch
- Low Pressure: 1 to 133 mPa

CHARACTERISATION Unit



OPTICAL

• 2 Horiba Jobin Yvon Spectroscopic Ellipsometers:
Based on optical polarisation for investigating the dielectric properties of thin films (complex refractive index, dielectric function). It can be used to characterise thickness, composition, roughness, crystalline nature, layer inhomogeneity (gradient, anisotropy). Single layers or complex multilayers from a few Å to several µm.
Uvisel: 200 nm - 2000 nm, variable angle, monochromator.
AutoSE: 440 nm - 1000 nm, mapping, spot views.

• Reflectometer
The NanoCalc Thin Film Reflectometry System allows to analyze the thickness of optical layers from 1 nm to 250 µm . Observation of single thickness with a resolution of 0.1 nm and single-layer or multilayer films in less than one second.

• Femto Laser – Spectra Physics (Mai-thai HP)
It is composed of a Ti-sapphire laser that is able to delivered impulsions of 100 fs. It can be used for pump-probe or Terahertz experiments.

• Femto laser – Coherent APE (OPO-PP automatic)
The femtolaser OPO-PP automatic can pump an optical parametric oscillator based on PPLN crystal on a scale from 1 to 6 µm and the duration of the impulsions is about 200 fs.

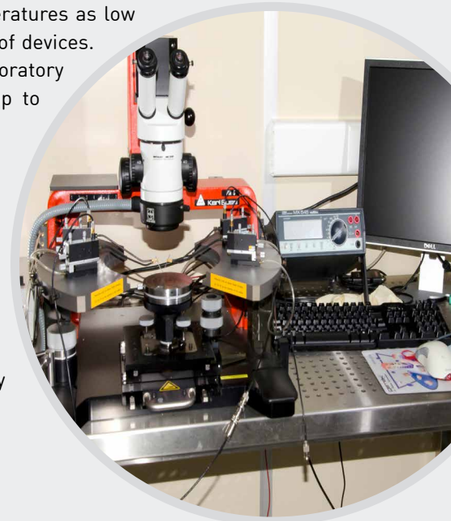
• Confocale miscroscope Leica
Used to increase optical resolution and contrast of a micrograph by using point illumination and a spatial pinhole to eliminate out-of-focus light

• µ-Photoluminescence & Raman Lab RAM HR
PL can be used for band gap measurement, alloys composition and thickness, Interface studies of heterostrucutres.
Raman can be used for graphene (strain, doping, thickness)

ELECTRICAL

• Hall Effect: The Accent HL5500PC is a turn-key, high performance Hall System for the measurement of resistivity, carrier concentration and mobility in semiconductors. Modular in concept, allowing easy upgrade paths, the system is suitable for a wide variety of materials, including silicon and compound semiconductors. It has both low and high resistivity measurement capabilities, with optional cryostats extending the temperature range from below 4K to as high as 600 K.

• Probe station: Two microwave probe stations are available in the IEMN for very low and high temperature applications. A cryogenic probe station allows us to perform microwave measurement up to 67GHz at temperatures as low as 4.7K. This test bench allows us to determine the noise model of devices. Another probe station has been developed and optimized in our laboratory in order to perform microwave measurements under probes up to 40GHz at very high temperatures up to 600K.



• The semilab WT-2000PVN system is a non contact platform for samples inspection (silicon, ...) quality control and process monitoring.
It is equipped with a variety of measuring options, including solar cell characterisations. It enables automatic mappings in the following modes:
- µ-PCD for determination of minority carrier lifetime
- LBIC for diffusion length and internal quantum efficiency evaluation on solar cells
- Eddy current for non-contact resistivity measurement
Thin film's Stress measurements

CHARACTERISATION Unit

SURFACE TOPOGRAPHY

AFM Edge (Bruker).

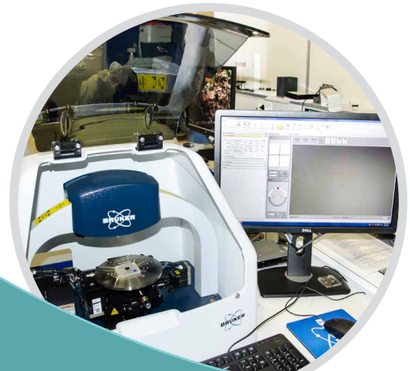
The AFM Edge is used for measuring very small dimensions such as step heights and roughness on different materials. Roughness around 0.1nm and step heights below 1nm can be measured. Peak Force Tapping™ allows making measurements without damaging surfaces and tips. The motorized table authorizes the positioning of large substrates with a scanning range of 100µm.

Contour GT X Optical profiler (Bruker)

The Contour GT-X is a stand-alone optical surface-profiling system. It measures surface topography with high accuracy in a range from fractions of a nm up to approximately 10mm. The system contains motorized x/y, tip/tilt and z stages to enable automated production monitoring. It is equipped with four interferometric objectives of magnification 2.5x, 10x, 50x and 115x.

3 Mechanical profilometers

They are used for measuring step heights from 10 nm to 1 mm. A stylus on a capacitive cantilever scans the profile of various types of matérials (resists, metallic plots and so on...). Scan range up to 6 inches are available.



MECHANICAL and PHYSICAL

Nano indenter

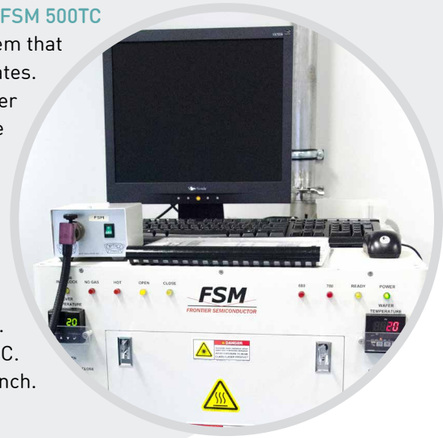
Nanoindentation is the primary method for measuring and testing very small volumes of mechanical properties.

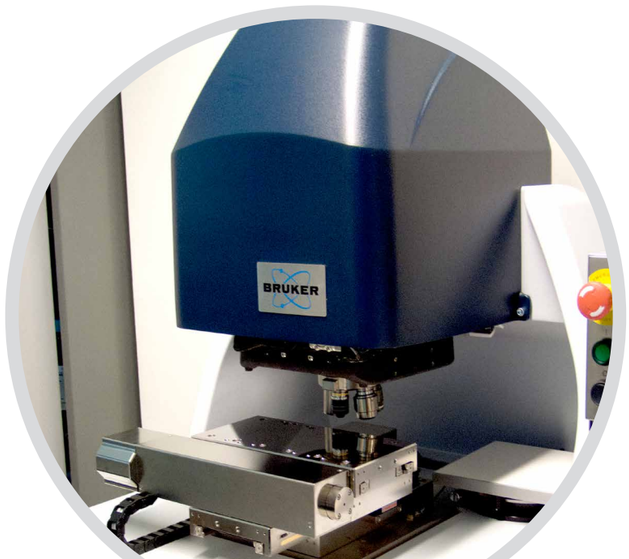
• Specifications with Continuous Stiffness Measurement:
- Maximum Depth - 500 µm
- Depth Resolution - <0.01 nm
- Maximum Load - 500 mN (10N high load)
- Load Resolution - 50 nN
• Specifications with Dynamic Control Module:
- Maximum Depth - 15 µm
- Depth Resolution - 0.0002 nm
- Maximum Load - 10 mN
- Load Resolution - 1 nN

FSM 500TC

The FSM 500TC is a thin film stress measurement system that can test the stress of different films on reflective substrates. The system uses a Non Destructive Optilever™ Laser Scanning technique to measure the change of curvature induced in a wafer due to a deposited film. It can measure stress hysterisis changes in the film during a heat cycle. It has an N2 ambient and a programmable temperature control system, allowing the evaluation of the thermal properties and stability of the films.

- Manual mapping possible
- Film Stress measurements with repeatability of 1.5%.
- Temperature range from room temperature to 500 °C.
- Wafer size from 2inch to 8inch.





Clean room safety rules

Working in clean-room
Badge strictly personal
No physical contact
Follow procedure to use equipments
Wear safety individual protection
Work with chemical at the right place
After use, clean the working place
Any entering object must be authorized and cleaned
Never work alone
In case of emergency, follow safety procedure
In case of doubt, ask a ressource responsible

Praca w pomieszczeniu czystym
Wejście do pomieszczenia tylko za pomocą osobistego identyfikatora
Bezpośredni kontakt z innymi - zabroniony
Przestrzegaj instrukcji użytkowania dla eksploatowanego sprzętu
Ubieraj indywidualne ubranie ochronne
Pracuj ze związkami chemicznymi tylko w wyznaczonych miejscach
Posprzątaj stanowisko po skończonej pracy
Wszystkie obiekty wnoszone do pomieszczenia czystego, muszą być zatwierdzone i oczyszczone
W pomieszczeniu czystym nie pracuj sam
W przypadku alarmu, postępuj zgodnie z procedurą ewakuacji
W przypadku wątpliwości, zapytaj osobę odpowiedzialną

Lavorare in camera pulita
Badge strettamente personale
Evitare il contatto fisico (per evitare la contaminazione tra persone e campioni)
Rispettare il protocollo di utilizzazione dei macchinari
Indossare l'equipaggiamento di protezione
Maneggiare i prodotti chimici negli ambienti appositi ad essi adibiti
Dopo l'uso, pulire l'ambiente di lavoro
Ogni oggetto introdotto deve essere precedentemente autorizzato e pulito
Mai lavorare soli
In caso di emergenza, rispettare le procedure di sicurezza
In caso di incertezza, domandare ad un responsabile delle risorse

Le travail en salle blanche
Badge strictement personnel
Pas de contact physique
Respecter le protocole d'utilisation des équipements
Utilisation les équipements de protection
Manipulation des produits chimiques aux endroits réservés
Nettoyer le plan de travail après utilisation
Tout objet entrant en salle blanche doit être autorisé et nettoyé
Pas de travail isolé
En cas d'alarme, suivez la procédure d'évacuation
En cas de doute, demander à un responsable de ressource

Cleanroom में कार्य करते समय आवश्यक नियमों का पालन करे
अपना बिल्ला किसी को न दे
किसी के साथ भौतिक संपर्क न करें
उपकरणों का उपयोग करने के लिए प्रक्रिया का पालन करें
व्यक्तिगत सुरक्षाकवच पहनें
सही जगह पर रसायनों के साथ काम करें
प्रयोग करने के बाद, कार्यस्थल को साफ करें
किसी भी वस्तु को अंदर लाने से पहले साफ और अधिकृत किया जाना चाहिए
कभी अकेले काम न करें
आपातकालीन स्थिति में, सुरक्षा प्रक्रिया का पालन करें
किसी भी स्थिति में संदेह है तो एक उत्तरदायी व्यक्ति से पूछें

Temiz Oda Çalışma Kuralları
Temiz oda giriş kartınız yalnızca size mahsustur
Temiz odaya önlük ve aksesuarlar giymeden girmek yasaktır
Ekipmanları talimatlarına göre kullanınız
Kimyasallara karşı koruyucu önlük ve aksesuarları kullanınız
Kimyasalları sadece kendi çalışma alanında kullanınız
Kullandıktan sonra her ekipmanı ve çalışma alanını temiz tutunuz
Temiz odaya soktuğunuz her eşya temiz ve izin dahilinde olmalıdır
Temiz odada tek başınıza iken çalışmayınız
Tehlike anında, güvenlik kurallarına uygun hareket ediniz
Şüpheye düştüğünüz bir anda yetkili birine danışmaktan çekinmeyiniz

العمل في القاعة البيضاء
شخصية بحتة شارة
يمنع أي اتصال جسدي
اتبع الإجراءات لاستخدام المعدات
ارتداء حماية السلامة الفردية
العمل مع المواد الكيميائية في المكان المناسب
تنظيف مكان العمل بعد الانتهاء
يجب تنظيف اي شيء ثم ادخاله للقاعة البيضاء مع السماح به فيها
داخل القاعة البيضاء عدم العمل وحيدا
السلامة في حالة الطوارئ ، اتبع اجراء
من مسؤول في حالة الشك ، اطلب المساعدة

1.门卡仅限本人使用
2.严禁身体接触
3.严格遵守仪器的使用规则
4.必须穿超净服，超净鞋，戴手套
5.使用化学药品时，需在规定的位置操作
6.使用完毕后，需清理工作平台
7.任何需带入超净间的物品，必须获得许可，并且需在更衣室进行清洁
8.在非正常工作时间，严禁独自在超净间工作
9.出现紧急情况时，遵守安全疏散流程
10.遇到问题，询问相关负责人

Das Badge ist personenbezogen (nicht weitergeben)
Kein physischer Kontakt mit anderen Personen
Bedienungsanleitungen der Geräte beachten
Schutzkleidung benutzen
Benutzung chemischer Produkte nur an den dafür vorgesehenen Plätzen
Nach Benutzung die Arbeitsfläche säubern
Jedes in den Reinraum eingeschleuste Objekt muss autorisiert und gesäubert werden
Nicht alleine arbeiten
Im Alarmfall den Reinraum verlassen
Bei Unklarheit die verantwortliche Person fragen

Немедленно прекратить свою работу
Информировать всех окружающих об эвакуации
Перекрыть газ и электричество
Открыть окна и двери, не запирая их
Покидая помещение, убедиться, что в нем никого не осталось
Не пользоваться лифтом и грузовым лифтом
Проследовать к выходу спокойно и без спешки
Не возвращаться в помещение
Следовать инструкциям ответственного за эвакуацию
Добраться до места общего сбора: на входе в IEMN

クリーンルーム利用規則
必ず本人のバッジを使用のこと
身体の接触をさけること
装置使用手順を遵守すること
手袋、防塵シューズ・マスク、帽子等を着用のこと
薬品類は所定の場所でのみ使用のこと
使用後は清掃すること
外部からの持ち込みは必ず許可を受け、汚れを落とした物のみとする
単独での使用は禁止（二人以上で作業すること）
アラームが鳴った場合は、避難マニュアルに従うこと
不明点がある時は、施設責任者に確認すること

Praca w pomieszczeniu czystym
Wejście do pomieszczenia tylko za pomocą osobistego identyfikatora
Bezpośredni kontakt z innymi - zabroniony
Przestrzegaj instrukcji użytkowania dla eksploatowanego sprzętu
Ubieraj indywidualne ubranie ochronne
Pracuj ze związkami chemicznymi tylko w wyznaczonych miejscach
Posprzątaj stanowisko po skończonej pracy
Wszystkie obiekty wnoszone do pomieszczenia czystego, muszą być zatwierdzone i oczyszczone
W pomieszczeniu czystym nie pracuj sam
W przypadku alarmu, postępuj zgodnie z procedurą ewakuacji
W przypadku wątpliwości, zapytaj osobę odpowiedzialną

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