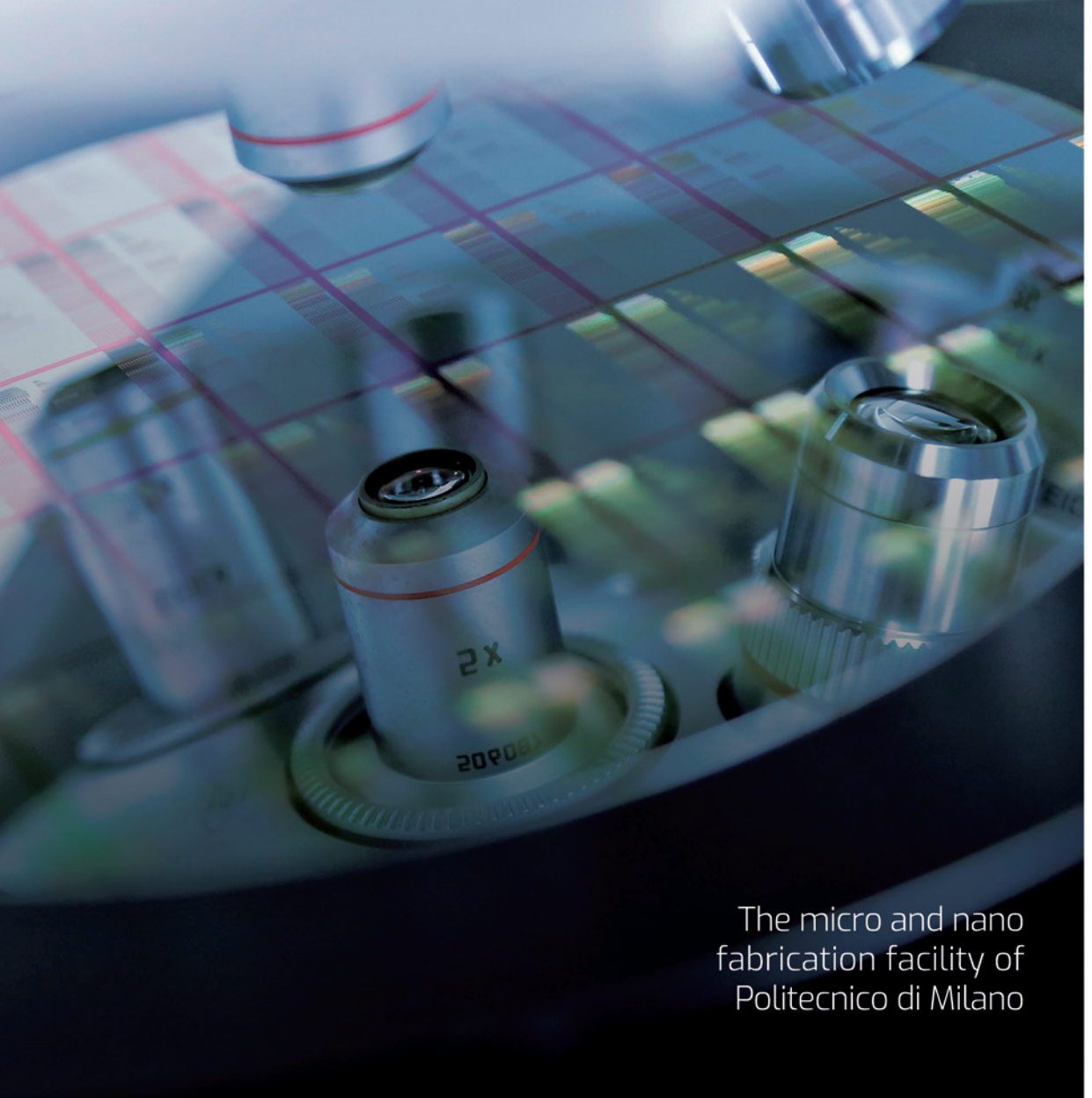


The micro and nano
fabrication facility of
Politecnico di Milano

polifab
POLITECNICO DI MILANO

Polifab

Polifab is the open-access, micro and nanofabrication facility of Politecnico di Milano, created to provide the highest technological standards for a wide range of applications and processes involving the Key Enabling Technologies: photonics, micro and nanoelectronics, biotechnologies, advanced materials and nanotechnology.

Polifab houses 8M€ of nanofabrication and technological tools in a 370 m^2 cleanroom, managed by three technicians and staff personnel from research groups of Politecnico di Milano.

The cleanroom is equipped with advanced instrumentation for the research and development of new materials, technological processes and devices at the micro- and nano-scale.

Polifab is located in the academic environment of the Campus Leonardo of Politecnico di Milano.

Vision

At Polifab, enabling technologies are blended in a multidisciplinary environment, where each scientific branch is synergic to the others. Mastering these technologies means being at the forefront of the route towards knowledge-based economy.

Cross-fertilization of knowledge is the future of science and education, as well as the keystone for innovation and competitiveness of both academic and industrial research.

Strategy

Polifab targets fundamental, applied and commercial research and development in collaboration with universities, research institutes and industries. It supports and stimulates the development of technologies, materials, devices, systems and solutions, generating an IP portfolio of multidisciplinary competencies.

Polifab acts as nucleation center for the creation of laboratories clusters and joint research activities, promoting research and education in the key emerging technologies.

Three research laboratories, from the Department of Electronics, Information and Bioengineering (DEIB) and the Department of Physics, are built around Polifab since its foundation.

Mission

The mission of Polifab is to support and boost micro and nanotechnology activities carried out by research groups of Politecnico di Milano, external research institutions and industries.

Polifab aims at aggregating users active in education, scientific research, development and prototyping through collaborations and strategic alliances with external partners. As a consequence of this catalytic action, Polifab users gain competitiveness on the European scenario.

History

The birth of Polifab is connected to the donation of equipment and infrastructures of Pirelli Labs to Politecnico di Milano.

2011 December
Transfer of machines and infrastructures from Pirelli Labs to Politecnico

2012 June
The academic senate approves the Polifab project

2013 October - **2014** February
Cleanroom realization

2014 April - November
Installation of equipment and start up

2014 December
First wafers processed

2014 Fall - **2015** Spring
Transfer and installation of research laboratories

2015 March
Access to Polifab of first users

2015 July
Official inauguration of Polifab

2015 October
First invoice for service

2016 June
First publication on Nature Nanotechnology

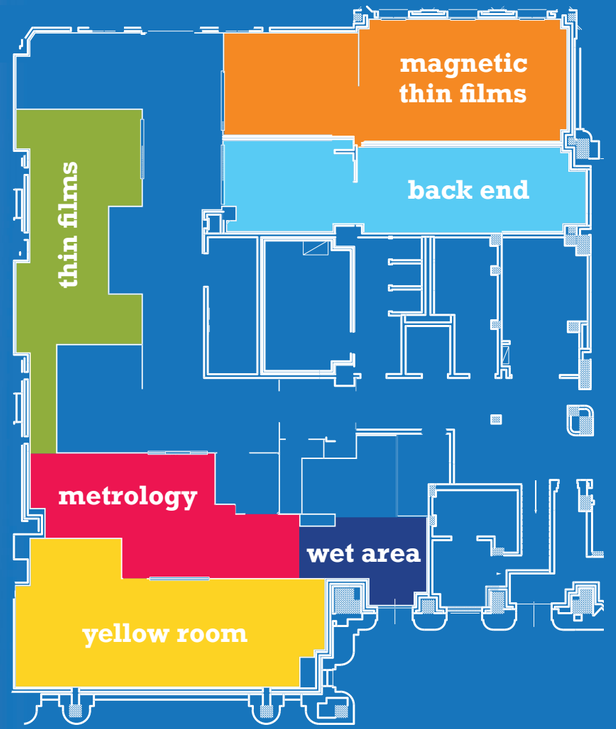
2017 July
100 registered users

Layout

150 m² class ISO06

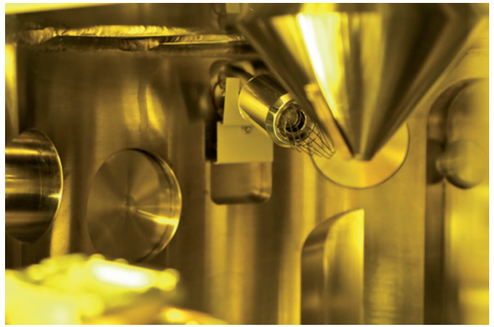
220 m² class ISO08

6'' wafers



Processes and equipment

The cleanroom is designed to operate on substrates up to 6 inches.



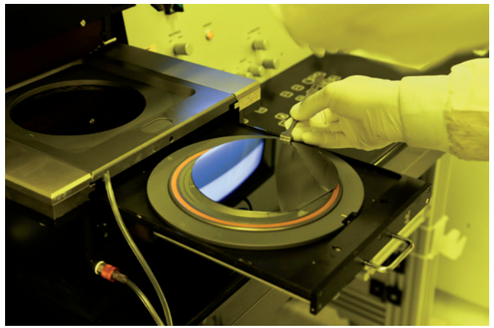


Photo and electrom beam lithography

Mask Aligner - Karl Süss MA6/BA8:
1000 W mercury lamp, proximity, soft, hard and vacuum contact, back side alignment.

Maskless Aligner - Heidelberg MLA100:
365 nm wavelength, substrates up to 8" x 8", write speed of 50 mm²/min, grey-scale with 256 levels.

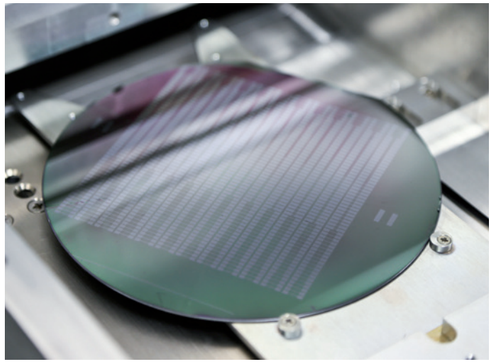
SEM and EBL System - LEO 1525 / Raith Elphy Plus:
high resolution FE-SEM, accelerating voltages from 0.5 kV to 30 kV. EBL resolution: 20 nm. Samples up to 2".

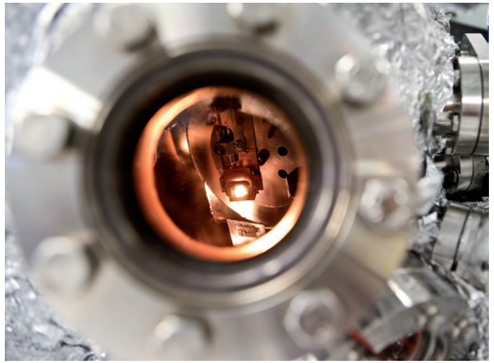
Spin Coater - Karl Süss RC8:
with adapters for samples from 1" to 6".

Hot Plates:
temperature range: 25 - 250 °C, accuracy: +/-1 °C, from fragments to wafers up to 12".

Wet benches + Spin Rinse and Dryer - Semitool:
resist development and wafer cleaning.

Optical Microscope - Leica INM 200:
motorized x-y stage, visible and UV light, objectives from 2.5x to 100x.





Dry etching

ICP Reactive ion etching - Oxford Plasmalab 100:
RIE power up to 600 W and ICP power up to 2000 W, SF_6, O_2, CHF_3, C_4F_8 gases.

Ion beam etching - Kaufman source KDC 160:
Ar gas, beam voltage 200 - 850 V, motorized rotating and tilting holder, ±15% thickness uniformity on 6" wafers.

Plasma Asher - PVA TEPLA 200:
Ar and O_2 gas, maximum power 400 W.

Thin films deposition

Chemical Vapor Deposition - STS Multiplex:
for SiO_2, SiO_xN_y, SiN, a-Si:H deposition, Gas: SiH_4, NH_3, N_2O, O_2, CF_4, substrates up to 8".

Magnetron sputtering systems - Leybold LH Z-400 and Kenosistec VS80:
DC and RF for metals and oxides (Cr, Au, ITO, SiO_2, SiC), substrates up to 3".

E-beam Evaporator - Evatec BAK 640:
6 pockets rotating crucible, up to nine 6" wafers per run, metals and oxides.

Pulsed Laser Deposition:
1" samples, Nd:YAG Q-switch laser.

Molecular Beam Epitaxy:
UHV deposition of metals and oxides.

Electroplating:
Deposition of Au and Ni on 1-2" samples.

Wet processes

Wet benches for chemical etching:
acids and bases with heated reaction baths and automatic rinse/drain tanks for single- and multi-wafer process.

Wet benches for lift-off:
solvents with heated reaction baths and sonicator.

Annealing

Drying oven - Heraeus UT6060:
low temperatures curing (300 °C).

Muffle furnace - Nabertherm LT 9/11 SKM:
up to 1100 °C in 90 minutes, 9 l internal volume, under N_2 flux.

Horizontal quartz tube furnace - Carbolite Gero KST 12/600:
up to 1200 °C, inert atmosphere during heating (N_2) and annealing in vacuum.

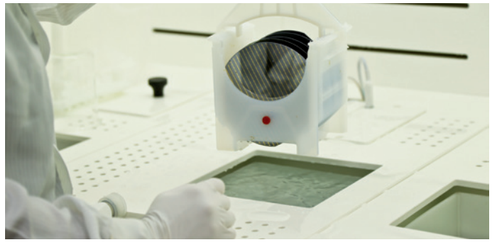
Back-end

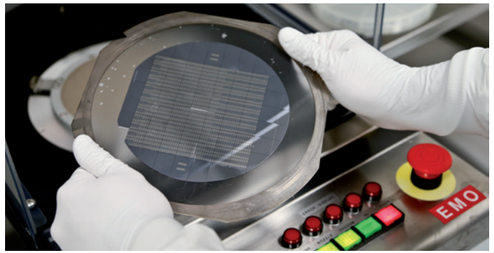
Dicing saw - DISCO DAD 341:
including wafer mounting and cleaning for semiconductor, ceramic and glass wafers.

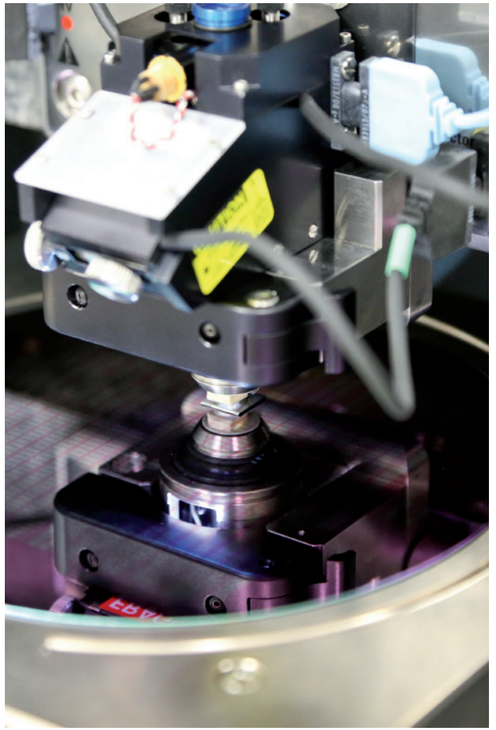
Automatic wafer diamond scriber - Dynatex GST-150:
< 5 µm scribe line, adjustable scribe angle, scribe speed up to 10" per second.

PDMS and microfluidic facilities:
including spin coater, hot plate, drying oven.

Ball bonder - Kulicke & Soffa 4124:
Au wire, 95 x 95 mm^2 bonding area.







Characterization

Atomic force microscope - Keysight 5600LS:
substrates up to 8", fully addressable and programmable stage, Magnetic, Electrostatic, Kelvin Probe and Piezoresponse Force Microscopies.

Electric Probe System - SÜSS MicroTec PM5:
with heated chuck.

Spectroscopic ellipsometer - J.A. Woollam VASE:
260 nm 1700 nm, incidence angle from 15 to 90 degrees, up to 8" wafers.

Stylus profilometer - KLA Tencor P15:
measured thickness in the range 10 nm - 327 µm, 3D topography mapping, stress measurement.

Prism coupler - Metricon:
thickness and refractive index measurement, 632.8 nm, 1320 nm and 1554 nm wavelength.

Optical microscope - LEICA FTM 200:
three axes, motorized, with autofocus.

Wafer thickness measurement - Eichhorn & Hausmann MX 203:
thickness range 400 - 1000 µm, resolution 1 µm.

How to access

Polifab is an open-access, pay-per-use facility, open to research groups of Politecnico as well as to external research institutions and industries.

Researchers can enter the cleanroom and become users of the facilities, after specific training courses given by the technical staff of Polifab. Processes can be run directly by the technical staff of Polifab and offered as a service to external companies or research groups.

To access the cleanroom facilities first contact the Polifab staff to discuss your technological needs, verify the feasibility of your ideas, and identify the model of use: service or user.

Service model

The Polifab staff executes the required processes, characterization or prototyping within the framework of a research or service contract. No direct access of personnel from the external group or company is required.

User model

New cleanroom users must attend a safety course and obtain a Polifab access certificate. Specific machine and process training is given by the technical staff of Polifab.

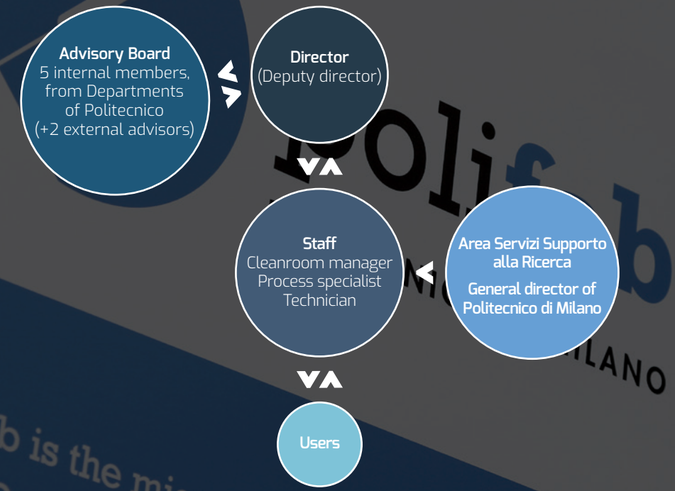
Information on the cleanroom status, machine maintenance and operation, and access limitations are shared with all the users through the Polifab mailing list.

Booking

Shared access to cleanroom facilities is regulated by a booking system available in the Polifab intranet.

Information on the booking procedure can be found on our website: **www.polifab.polimi.it**

Organization chart



Advisory Board

Prof. Andrea Leonardo Lacaita
Prof. Riccardo Bertacco
Prof. Alberto Corigliano
Prof. Ferruccio Resta
Prof. Sandro De Silvestri
Prof.ssa Marinella Levi
Ing. Bruno Munari
Prof. Rinaldo Cubeddu

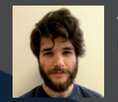
Staff

Director
Andrea Leonardo Lacaita

Deputy Director
Riccardo Bertacco

Cleanroom manager
Claudio Somaschini

Process specialist
Alessia Romeo

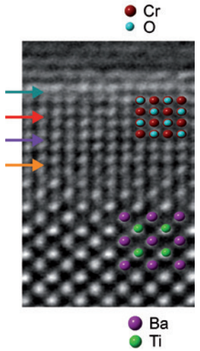


Technician
Lorenzo Livietti

Highlights

Epitaxial growth and patterning of ferroelectric and magnetic materials

M. Asa, S. Varotto, C. Rinaldi, M. Cantoni
Department of Physics - Politecnico di Milano

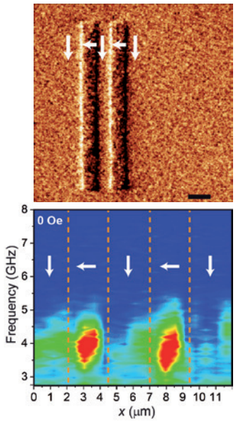


Transmission electron microscopy image of a Cr_2O_3/$BaTiO_3$ heterostructure grown by PLD and MBE

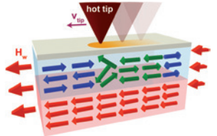
Patterning of ferroelectric domains by Piezoresponse Force Microscopy

Reversible patterning of spin textures in ferromagnets

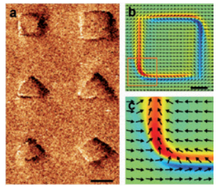
E. Albisetti, D. Petti
Department of Physics - Politecnico di Milano



Excitation and channelling of spin-waves



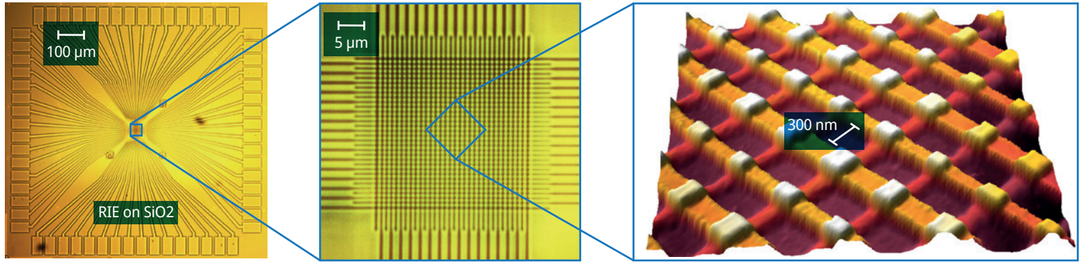
Thermally assisted magnetic scanning probe lithography (tam-SPL)



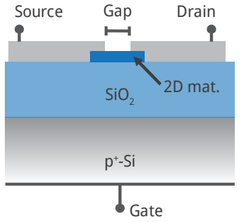
Magnetic patterning of spin textures

Develoment of resistive switches for in-memory computing

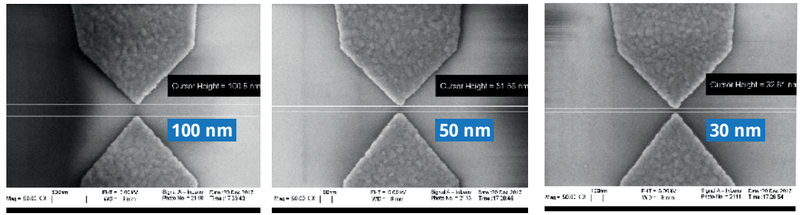
A. Bricalli, D. Ielmini
Department of Electronics, Information and Bioengineering - Politecnico di Milano



Memristors crossbar array

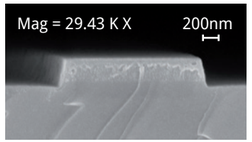


2D transistor with nanoscale channel

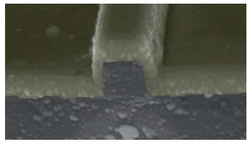


Integrated photonic devices

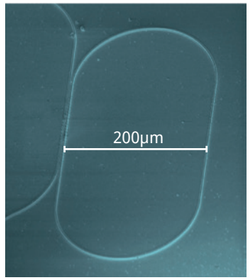
A. Melloni, F. Morichetti
Department of Electronics, Information and Bioengineering - Politecnico di Milano



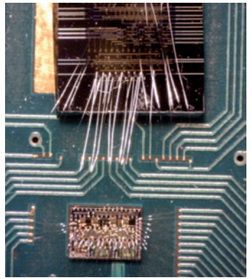
SiON and SiOC high index-contrast waveguides



$BaTiO_3$ coated silicon waveguide



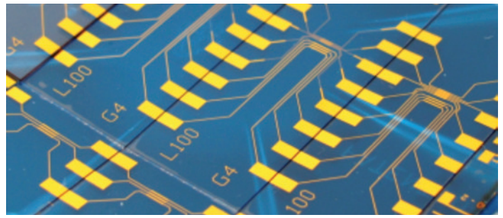
$BaTiO_3$ enabled silicon photonic microring resonator

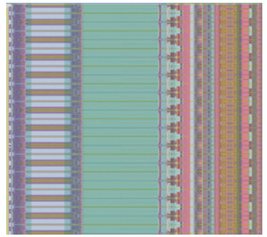


Assembled silicon photonic chip and CMOS ASIC

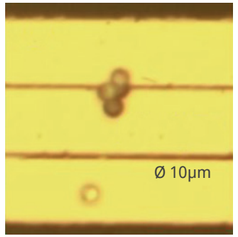
Dielectric detection of airbone dust: tracking & sizing of particle matter (PM)

M. Carminati, G. Ferrari, M. Sampietro
Department of Electrons, Information and Bioengineering - Politecnico di Milano





32 channels assembled chip for dust sizing



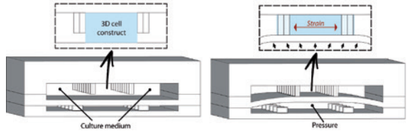
Au microelectrodes for PM10 testing

Organs on chip and microfluidics

M. Rasponi
Department of Electronics, Information and Bioengineering - Politecnico di Milano

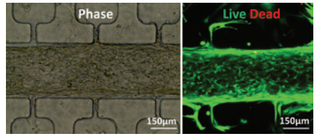
Heart Models: cardiomyocytes-based beating 3D constructs electro-mechanically stimulated for tissue maturation, contractile measurements and perspective cardiotoxic drug screening.

Cartilage models: cartilage/bone-based 3D constructs mechanically stimulated (compression) to study joint development or diseases such as Osteoarthritis.

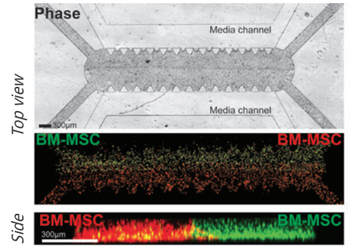


Mechanical actuation system

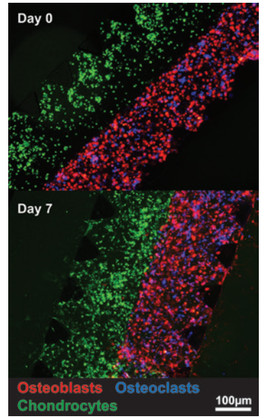
Contractile cardiomyoctes



Cartilage construct under mechanical compression



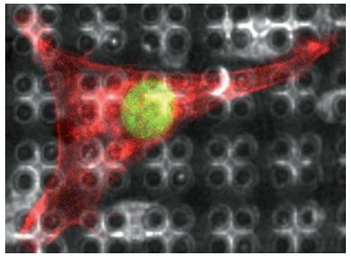
Multi-compartment 3D microtissue



Osteo-chondral joint microtissue

Magnetically actuated micro-pillars for mechanobiology

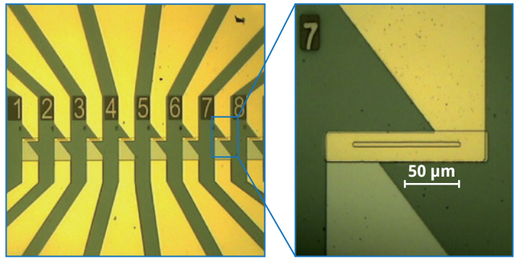
M. Monticelli, R. Bertacco
Department of Physics - Politecnico di Milano



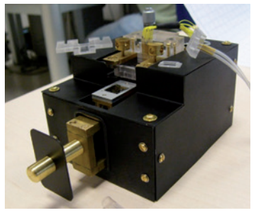
Active mechanical stimulation of single cells on Fe coated PDMS micro-pillars

Magnetic sensors based on tunneling junctions

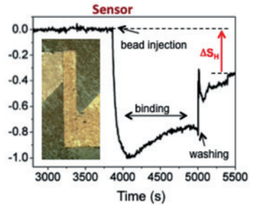
E. Albisetti, D. Petti, R. Bertacco
Department of Physics - Politecnico di Milano



Arrays of sensors based on magnetic tunnel junctions



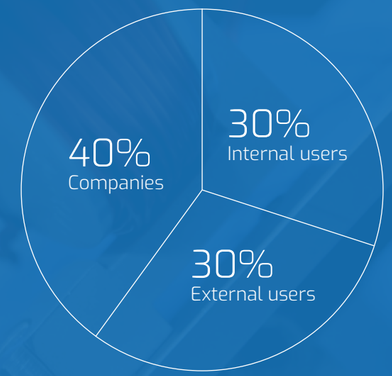
Prototype of diagnostic apparatus



Signals during a bioassay

Figures of merit

	1st year (2016)	2nd year (2017)
Registered users	77	110
Research groups accessing Polifab	12	17
Contracts with companies	3	7
ERC projects based at Polifab	2	4
Other research projects	17	19
Students accessing Polifab for didactical and training activities	50	60



Contacts

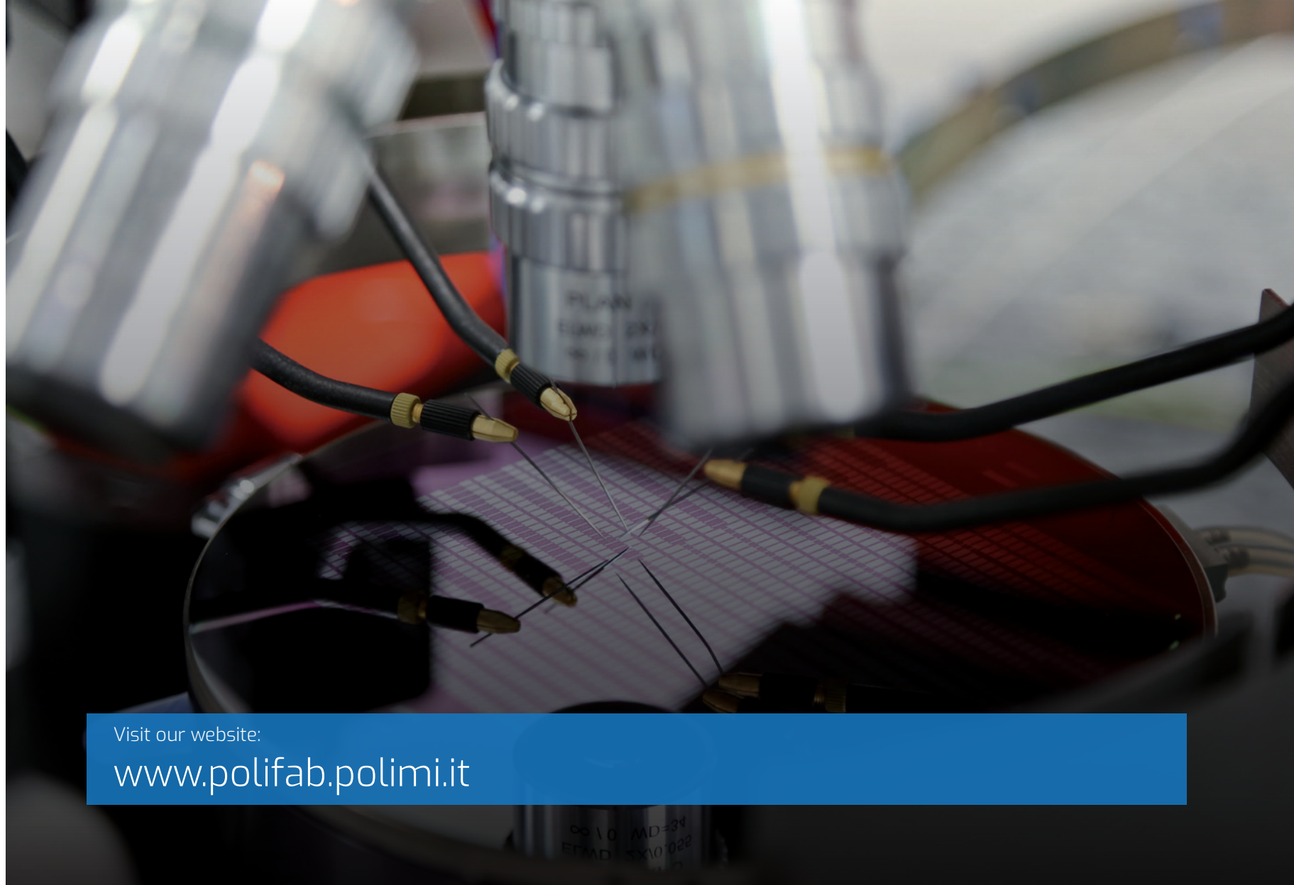
Venue

Polifab - Politecnico di Milano
Via Giuseppe Colombo, 81
20133 - Milano

www.polifab.polimi.it/venue

Contact us

infopolifab@polimi.it



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