



Next editions :

- ✘ 18<sup>th</sup> 02.05.2017
- ✘ 19<sup>th</sup> 08.05.2018

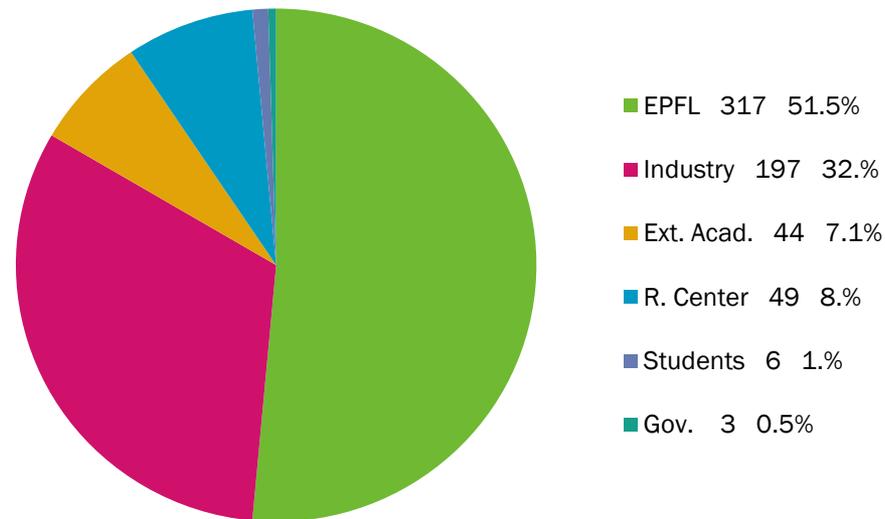
# EPFL MICRONANOFABRICATION ANNUAL REVIEW MEETING

# WELCOME & THANKS

- ✘ Welcome to the 17<sup>th</sup> edition of the CMi MicroNanoFabrication Annual Review Meeting
- ✘ 600 participants registered (with 30% from industry)
- ✘ Many thanks for your participation

- ✘ Global companies
- ✘ Local industry
- ✘ Startups
- ✘ Suppliers
- ✘ Government Agencies
- ✘ Researchers
- ✘ Faculty members
- ✘ Colleagues from other cleanrooms
- ✘ -> Traveling from over 12 countries

-> Networking



# WELCOME ADDRESS

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- ✘ Adrienne Corboud Fumagalli
- ✘ Vice-President for Innovation and Technology Transfer



# OUTLINE

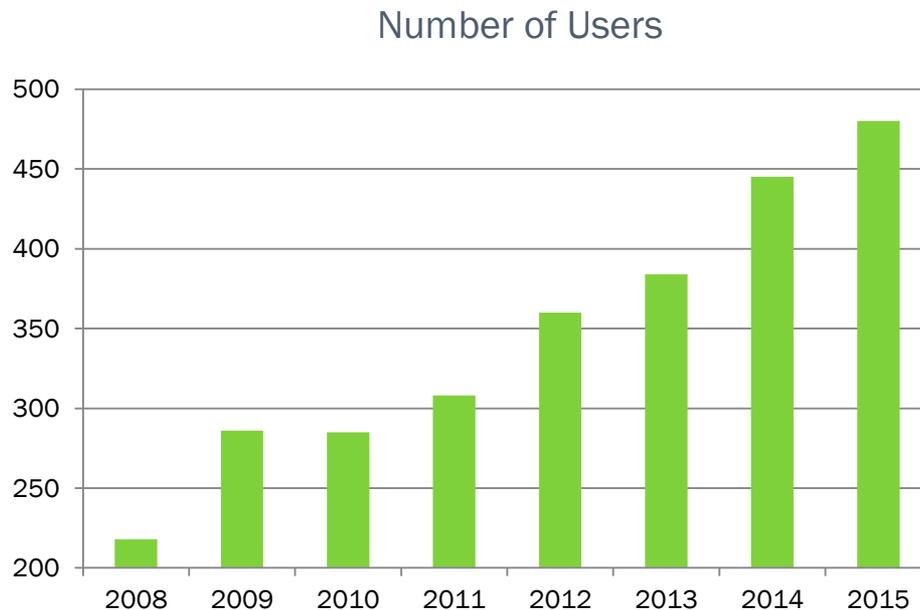
- ✖ Users
- ✖ Staff
- ✖ Cleanroom
- ✖ Tools
- ✖ Projects



# USERS IN 2015

EPFL Engineering Sc.	Basic Sc.	Life Sc.	Ext. Ac.	Companies	
STI-CMi	STI-IMT-LO	SB-IPHYS-LASPE	SV-BMI-LMNN	EXT-CERN	EXT-Aleva
STI-IBI-BIOS	STI-IMT-LOB	SB-IPHYS-LPMC	SV-GHI-UPKIN	EXT-CSEM	EXT-Asulab
STI-IBI-CLSE	STI-IMT-LPM	SB-IPHYS-LPMV	SV-IBI-LDCS	EXT-EMPA	EXT-Bruker
STI-IBI-LBEN	STI-IMT-LPMAT	SB-IPHYS-LPN	SV-IBI-LLCB	EXT-UNIBS	EXT-Debiotech
STI-IBI-LBNC	STI-IMT-LSBI	SB-IPHYS-LPQM	SV-IBI-UPDEPLA	EXT-UNIBE	EXT-EXALOS
STI-IBI-LBNI	STI-IMT-NAM	SB-IPHYS-LUMES	SV-IBI-UPLUT	EXT-UNIFR	EXT-Hamamatsu
STI-IBI-LHTC	STI-IMT-ESPLAB	SB-ISIC-LEPA	SV-ISREC-CDTSO	EXT-UNIGE	EXT-Hightec
STI-IBI-LNE	STI-IMT-INSTANT-L	SB-ISIC-LIP	SV-ISREC-UPSIM	EXT-UNIL	EXT-Intel
STI-IBI-TNE	STI-IMT-LAI	SB-ISIC-LPI		EXT-WyssCenter	EXT-Karmic
STI-IEL-GR-SCI	STI-IMT-LMTS	SB-ISIC-LSCI			EXT-LémanMicro
STI-IEL-LANES	STI-IMT-OPT	SB-ISIC-LSPM			EXT-LSPR
STI-IEL-LEMA	STI-IMT-PV-LAB		IC-ISIM-LSI		EXT-Lunaphore
STI-IEL-LSM	STI-IMT-SAMLAB		IC-ISIM-LSP		EXT-Mackinac
STI-IEL-NANOLAB	STI-IMX-FIMAP				EXT-Meister-Abrasive
STI-IEL-PHOSL	STI-IMX-LC				EXT-Morphotonix
STI-IEL-POWERLAB	STI-IMX-LMGN				EXT-Nanoworld
STI-IGM-LRESE	STI-IMX-LMM				EXT-Novagan
STI-IMT-GR-LVT	STI-IMX-LMOM				EXT-Patek
STI-IMT-GR-QUA	STI-IMX-LMSC				EXT-Qwane
STI-IMT-LAPD	STI-IMX-LP				EXT-Rolex
STI-IMT-LMIS1	STI-IMX-LTP				EXT-Sigatec
STI-IMT-LMIS2	STI-IMX-SMAL				EXT-SilMach
STI-IMT-LMIS4	STI-IMX-SUNMIL				EXT-Tronics
					EXT-ValFleurier
<b>309 (46)</b>		<b>60 (11)</b>	<b>41 (10)</b>	<b>29 (9)</b>	<b>41(24)</b>

# USERS IN 2015

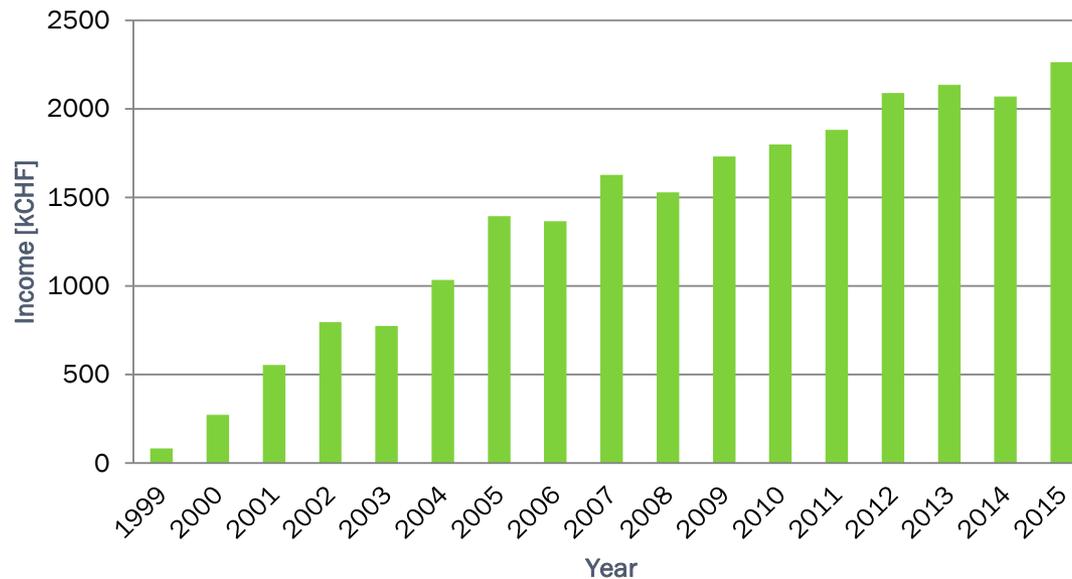


Nanofabrication plays an increasing role in modern science.

- ✗ The number of Users increased over the past 7 years at an average rate of 12% per year
- ✗ We have more than doubled the number of Users in 7 years
- ✗ Our prevision is to maintain the growth rate around 10% per year for the next 5 years (new labs)
- ✗ We will reach the number of 500 Users in 2016
- ✗ We observe some occupancy peaks with more than 50 Users simultaneously in the cleanroom

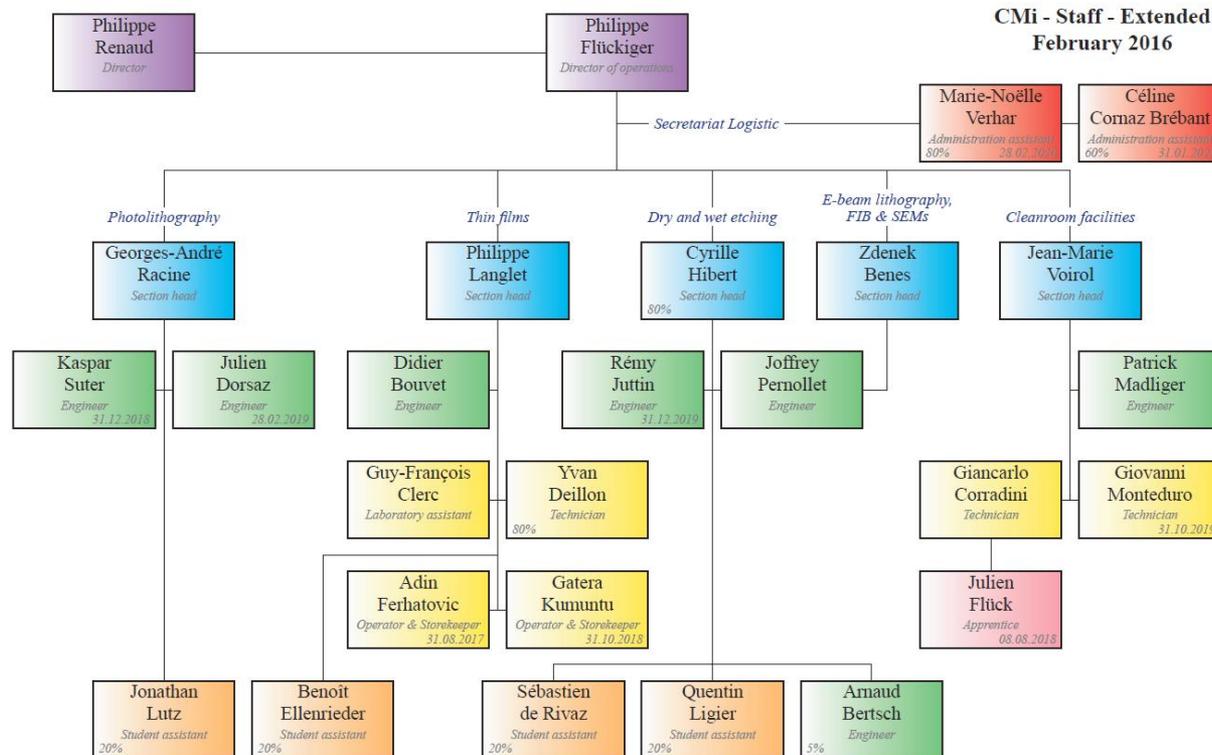
# USERS IN 2015

## Fees paid by the Users



- ✘ The fees paid by the users show a regular progression
  - + Monthly cap per user is applied
  - + Master students operate almost free of charge
- ✘ Discussions about the invoicing rules
  - + Eligibility rules from SNSF & Horizon 2020

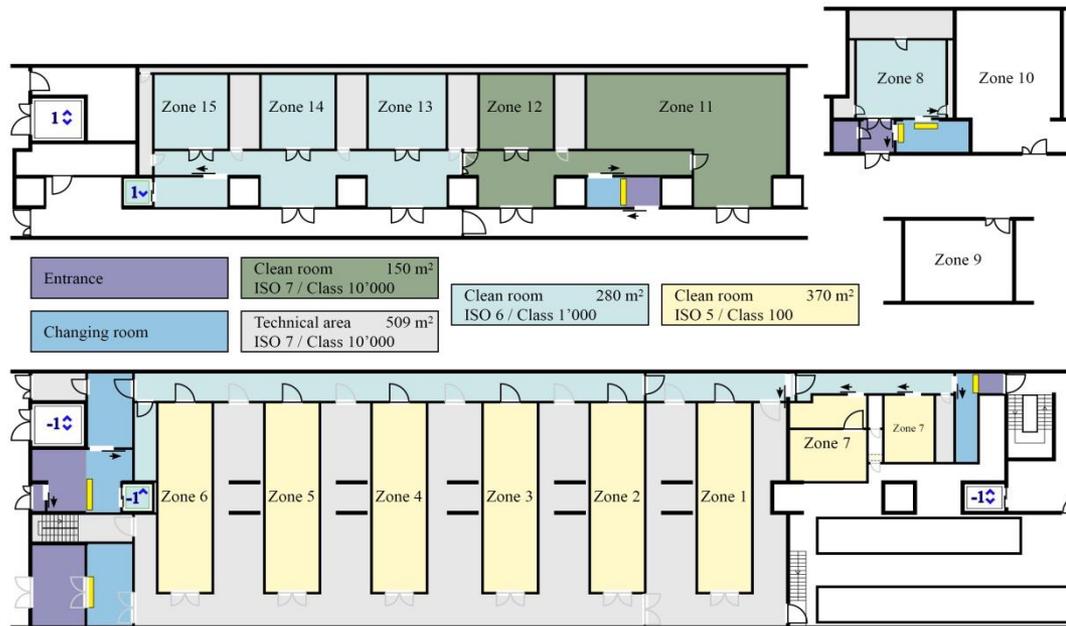
# THE STAFF



- ✘ 19 FTE staff members
- ✘ + Student assistants
- ✘ + Apprentices

# CLEANROOM

## CMi BM+1



## CMi BM-1

Initial surface (1998)	Extension (2010)	Total surface
1000m <sup>2</sup>	300m <sup>2</sup>	1300m <sup>2</sup>

- ✗ We have a total cleanroom surface of 1300m<sup>2</sup> on two levels connected by an elevator
- ✗ The cleanroom is almost full
- ✗ New space is required for installing new tools

# TOOLS INSTALLED/PURCHASED IN 2015

- ✘ Electronics Upgrade of the 10 existing furnaces
- ✘ Installation of a TEOS furnace



- ✘ Coater Developer
  - + SUSS ACS200 Gen 3



- ✘ Mask Aligner
  - + SUSS MA6 Gen3



# SUCCESSFUL R'EQUIP 2015

## ✘ ALD tool for coating high aspect ratio materials

- + Prof. Jeremy Luterbacher
- + Coating of particles [& magnetic materials ( $\text{Ni}_{80}\text{Fe}_{20}$ )]
- + Deadline for public tender : 02.05.2016



## ✘ RIE for etching dielectrics with ultra low roughness

- + Prof. Tobias Kippenberg
- + Etching of Dielectrics with ultra low roughness
- + Deadline for public tender: 02.05.2016



# WHICH LIST FOR THE FUTURE ?

## ✗ Maskless Aligner ?

- + Direct exposure of photoresist
- + In beta-site in CMi



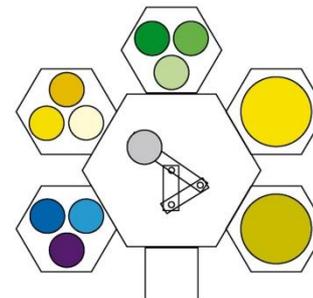
## ✗ New EBEAM writer ?

- + Better performances
- + Speed, Image placement, Field size, Edge fracturing
- + Stability & Uniformity



## ✗ PVD Cluster Tool ?

- + Thin film deposition of dielectric materials
- + Multilayers & Bragg reflectors
- + Co-sputtering of metals, nitrides & oxides



# REQUESTS DIRECTLY FROM LABS ?

✘ Plasma enhanced Chemical Vapor Deposition system ?

✘ Pulsed Laser Deposition system ?

✘ Vapor HF etcher ?

+ For the release of MEMS without stiction

# PUBLICATIONS HIGHLIGHTS 2016

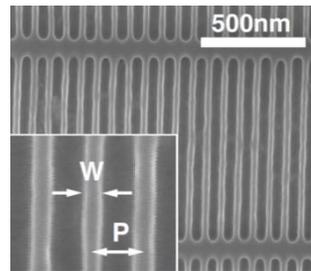
Over the last 12 months, 6 papers were published in Nature & Science with devices produced in CMi.

1°

*Science* 10 Jul 2015:  
Vol. 349, Issue 6244, pp. 165-168  
DOI: 10.1126/science.aab2051

Mid-infrared plasmonic biosensing with graphene

Plasmonic graphene biosensors

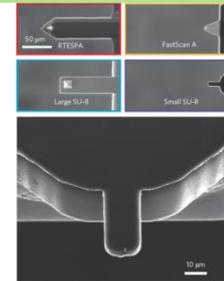


4°

*Nature Nanotechnology* 23 Nov 2015  
Volume: 11, Pages:147-151  
doi:10.1038/nnano.2015.254

Harnessing the damping properties of materials for high-speed atomic force microscopy

AFM tips

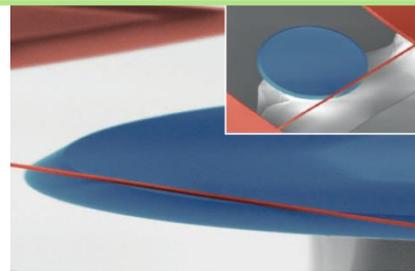


2°

*Nature* 10 August 2015  
Vol. 524, pp. 325-329  
doi:10.1038/nature14672

Measurement-based control of a mechanical oscillator at its thermal decoherence rate

Mechanical oscillators

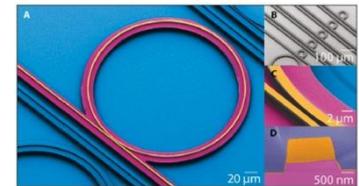


5°

*Science* 22 Jan 2016:  
Vol. 351, Issue 6271, pp. 357-360  
DOI: 10.1126/science.aad4811

Photonic chip-based optical frequency comb using soliton Cherenkov radiation

Photonic chips

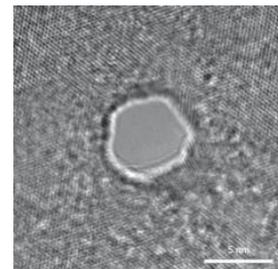


3°

*Nature Nanotechnology* 21 September 2015  
Volume: 10, Pages:1070-1076  
doi:10.1038/nnano.2015.219

Identification of single nucleotides in MoS2 nanopores

MoS2 nanopores biochips

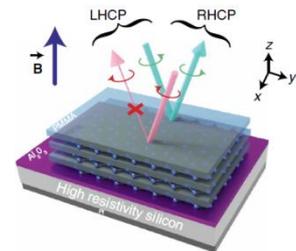


6°

*Nature Communications* 6 Apr 2016  
Volume: 7, Article number: 11216  
doi:10.1038/ncomms11216

Near optimal graphene terahertz non-reciprocal isolator

Terahertz graphene devices

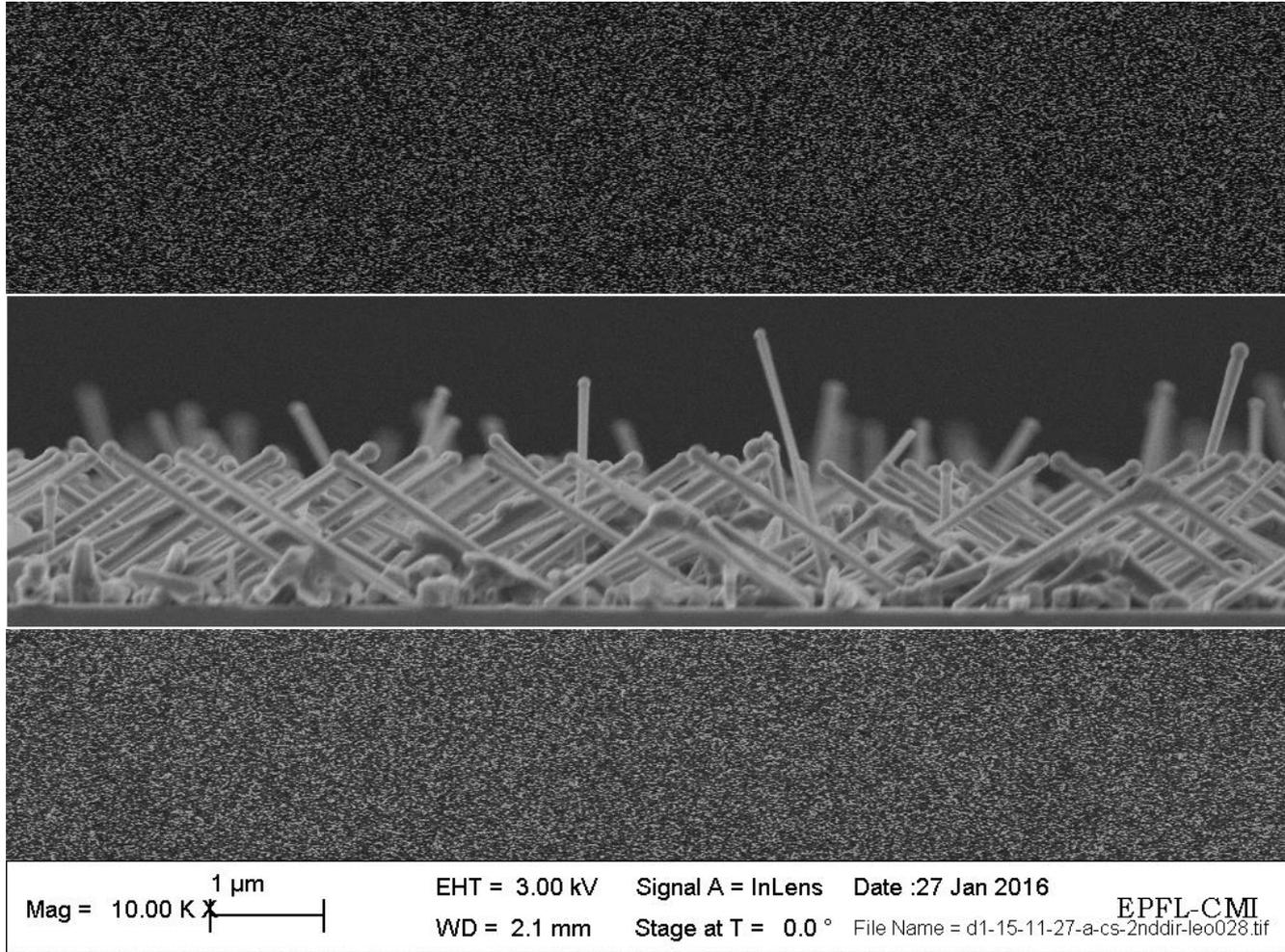


# ERC GRANTS 2016



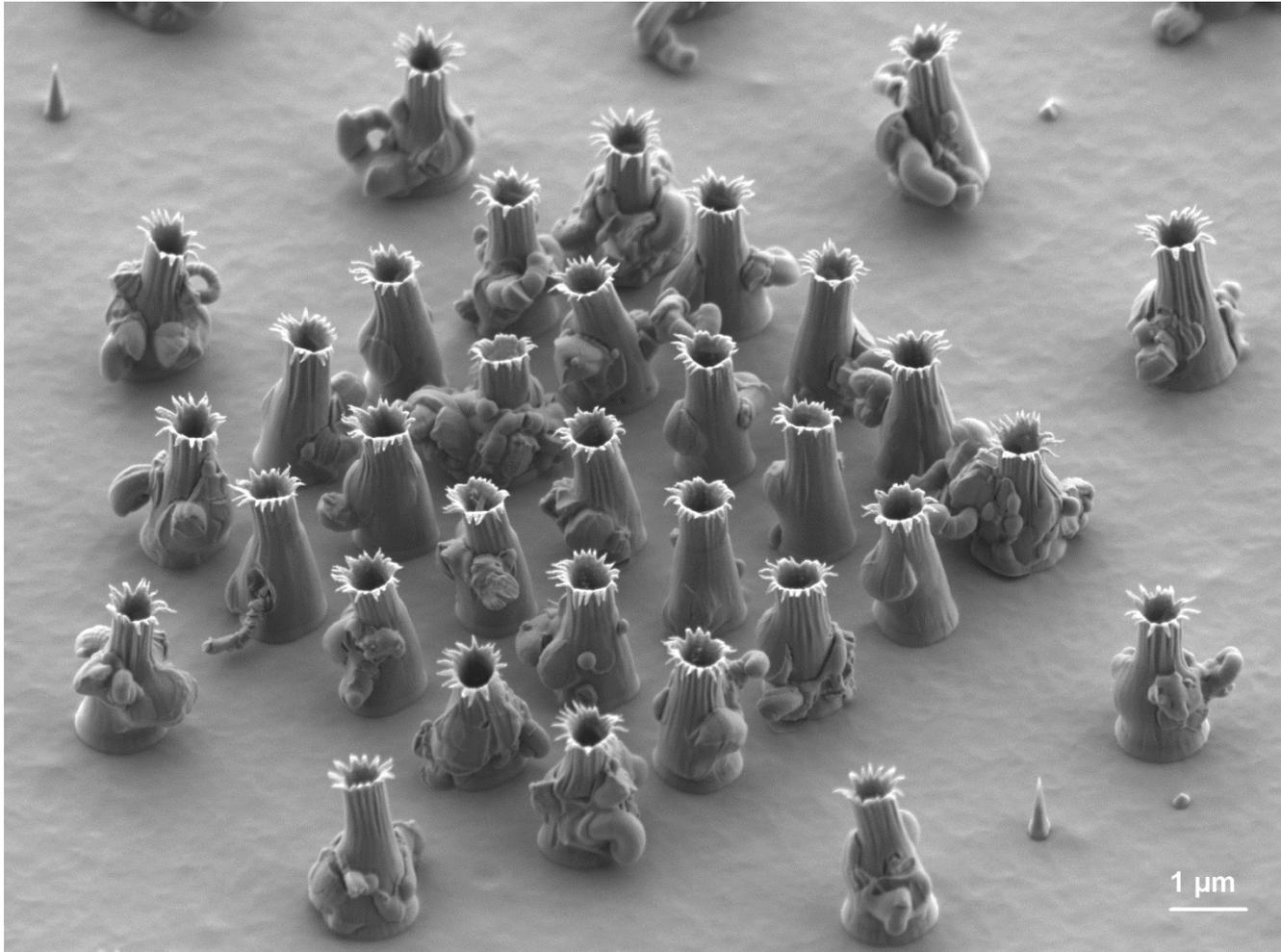
- ✘ 7 professors using the CMi have received an ERC Grants this year 😊
- ✘ 2 advanced + 2 consolidators + 2 starting + 1 Proof of concept

# PICTURE OF THE MONTH - JANUARY



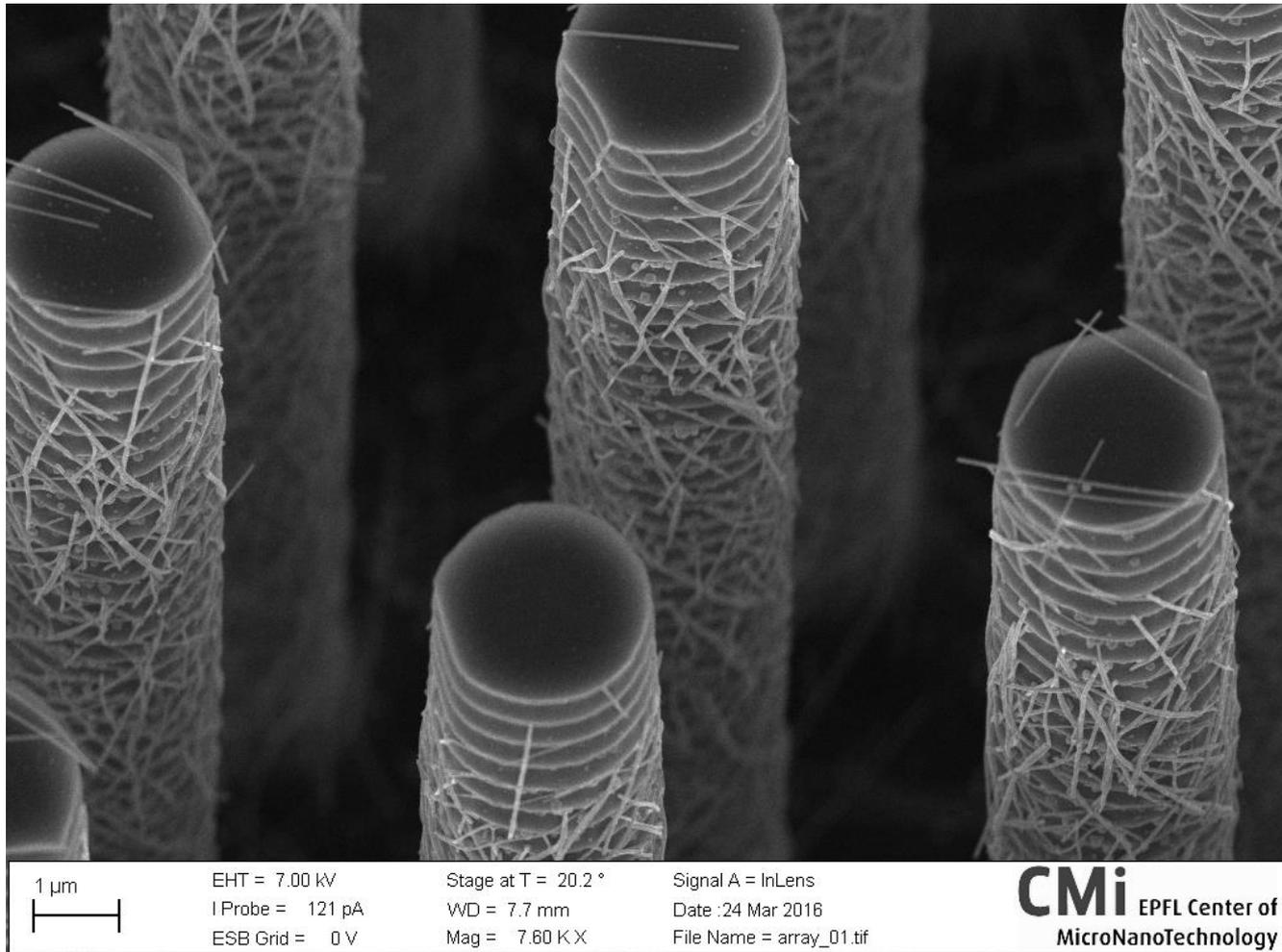
Micro-matchstick carpet  
Mahdi Zamani, LMSC

# PICTURE OF THE MONTH - FEBRUARY



Sunflower party  
Benoît Desbiolles, LMIS4  
Valentin Flauraud, LMIS1

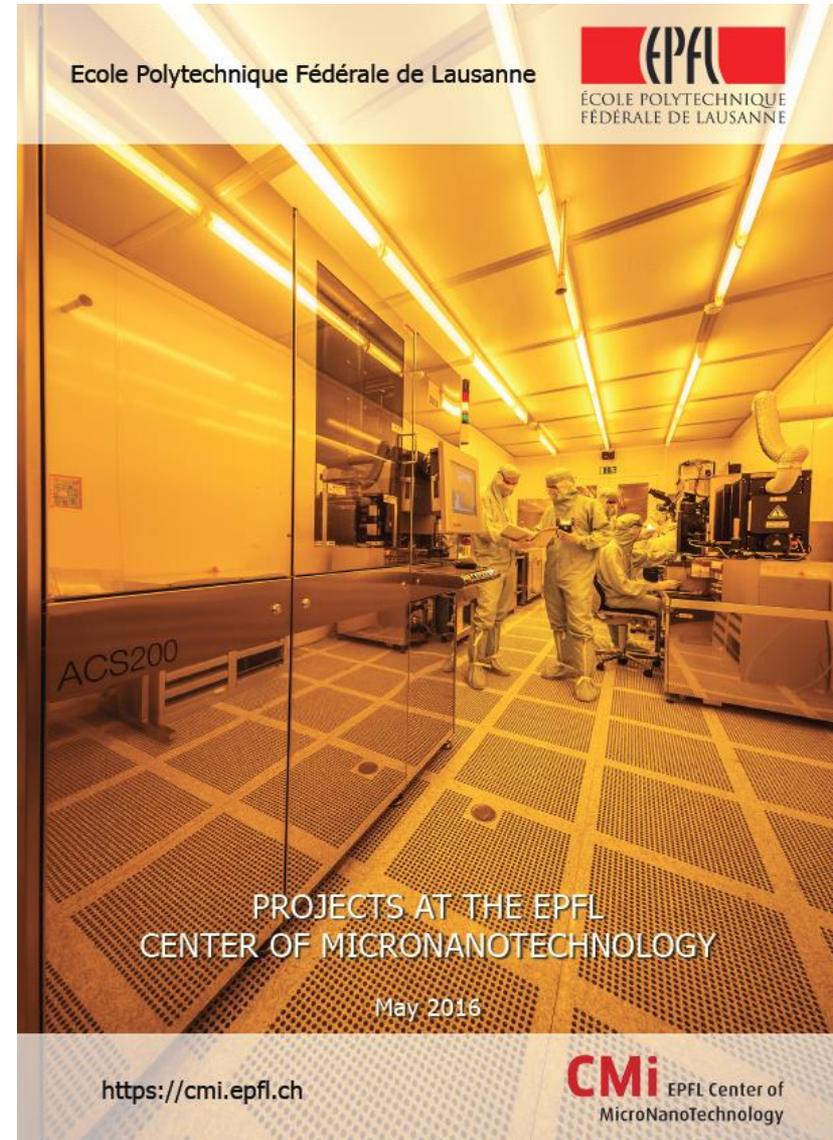
# PICTURE OF THE MONTH - MARCH



Liana around antic columns  
Dmitry Mikulik, LMSC  
Jelena Vukajlovic, LMSC

# ABSTRACTS IN 2016

- ✖ 217 posters collected in the brochure



# PROGRAM

- ✘ Very exciting program
- ✘ 10 presentations
- ✘ Spanning an exceptionally broad range
- ✘ Try to be different every year different
- ✘ Not always invite the heavy users
- ✘ Emphasize on the new Professors @ EPFL
- ✘ Sometime also some exotic users
- ✘ One common point:
  - + MicroNanoFabrication



## MicroNanoFabrication Annual Review Meeting

Date: Tuesday May 3<sup>rd</sup>, 2016  
 Time: 09h30 – 17h00  
 Place: EPFL, Forum Rolex Learning Center, RLC E1 240

### Program:

09h30-10h00	Coffees and Croissants, Distribution of Badges and Proceedings
10h00-10h05	<i>Adrienne Corboud Fumagalli</i> , Vice President for Innovation and Technology Transfer, Welcome address
10h05-10h15	<i>Philippe Flückiger</i> ( <a href="http://cmi.epfl.ch">http://cmi.epfl.ch</a> ), Introduction
10h15-10h45	<i>Takao Someya</i> , Organic Transistor Lab, The University of Tokyo, Microfabrication and flexible organic devices for wearable electronics
10h45-11h00	<i>Giovanni de Micheli</i> ( <a href="http://lsi.epfl.ch">http://lsi.epfl.ch</a> ), SiNW controllable-polarity transistors
11h00-11h15	<i>Niels Quack</i> ( <a href="http://q-lab.epfl.ch">http://q-lab.epfl.ch</a> ), Scalable on-chip optical switches based on silicon photonic MEMS
11h15-11h45	Break
11h45-12h00	<i>Aleksandra Radenovic</i> ( <a href="http://ben.epfl.ch">http://ben.epfl.ch</a> ), Nature inspired engineering-2D nanopores
12h00-12h15	<i>Dirk Grundler</i> ( <a href="http://imgn.epfl.ch">http://imgn.epfl.ch</a> ), Nanomagnets for magnonics: shrinking microwaves to the nanoscale
12h15-12h30	<i>Diego Ghezzi</i> ( <a href="http://lne.epfl.ch">http://lne.epfl.ch</a> ), Neuroprosthetics for vision restoration
12h30-14h30	Lunch & Poster Session
14h30-14h45	<i>Raphaël Butté</i> ( <a href="http://laspe.epfl.ch">http://laspe.epfl.ch</a> ), Short-wavelength III-nitride nanophotonic structures: a novel testbed for nanofabrication
14h45-15h00	<i>Eyad Assaf</i> ( <a href="http://hightec.ch">http://hightec.ch</a> ), HiCoFlex Technology, new dimensions of flexible multilayer HDI
15h00-15h30	Break
15h30-15h45	<i>Nikos Stergiopoulos</i> ( <a href="http://lhtc.epfl.ch">http://lhtc.epfl.ch</a> ), Using CMI capacities for the fabrication of implantable devices
15h45-16h00	<i>Sébastien Lani</i> ( <a href="http://csem.ch">http://csem.ch</a> ), Light steering with a MEMS scanner
16h00-17h00	Cocktails & Poster Session

# ENJOY THE CONFERENCE



# THANKS FOR YOUR ATTENTION

