



2010 : TUESDAY MAY 18TH

EPFL Center of MicroNanoTechnology
10
Year Celebration
1999-2009

EPFL MICRONANOFABRICATION ANNUAL REVIEW MEETING

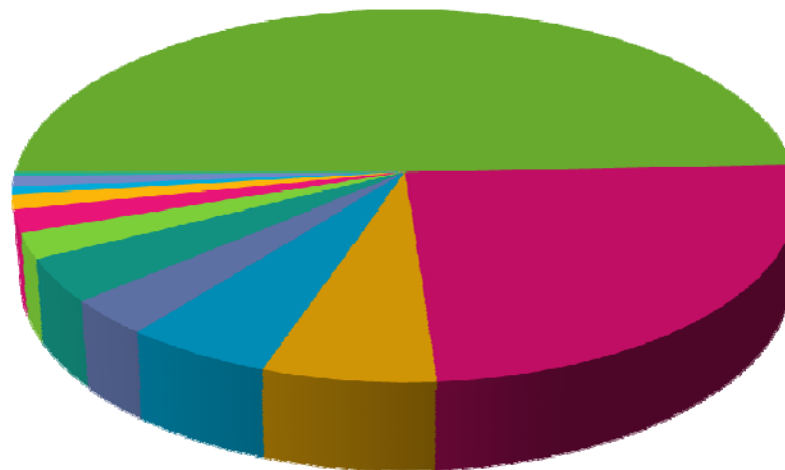
WELCOME & THANKS

- ✘ Welcome !
- ✘ Many thanks:
 - + Many thanks to the speakers of today
 - + Many thanks to the users of the CMI for submitting 134 abstracts
 - + Many thanks to the users of the CSEM's Microsystems Technology Division for submitting 11 abstracts
 - + Many thanks to Claudia and Karine for the great job in organizing this meeting
 - + Many thanks to the EPFL who is strongly supporting the CMI
 - + And last but not least thank you to all of you for being with us today

PARTICIPANTS

Participants

Total: 325 participants (+27%)



- EPFL-STI 49%
- Industry 24%
- EPFL-e 6%
- EPFL-SB 5%
- CSEM 3%
- ETHZ 3%
- EPFL-SV 2%
- Uni 1%
- R. Cent. 1%

This is quite an interesting mix of population for technology transfer !

ABSTRACTS



145 abstracts from :

- 34 laboratories of EPFL (STI, SB, SV, IC)
- 5 external laboratories
- 3 divisions of CSEM
- 13 Private companies

+13 % in 2009 compared to 2008

Field	# of abstracts
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BioEngineering	37
MEMS	30
Electronics	24
Fabrication	22
Materials	17
Optics	15

USERS IN 2008

- ✘ 218 users in total
 - + 191 users from EPFL labs
 - + 27 users from outside of EPFL
- ✘ 40 laboratories of EPFL
- ✘ 6 external research laboratories
- ✘ 16 private companies
- ✘ Several new labs in the ramp-up phase (bio, nano, physics, materials)

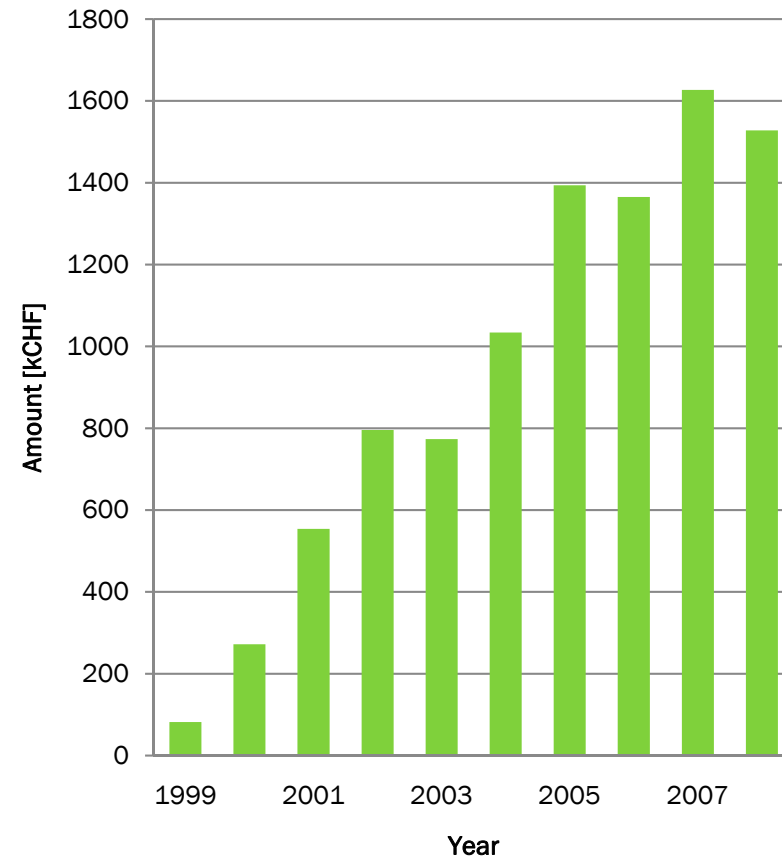
At the end of the day it is really a great benefit to have all these labs sharing information within the same platform !

	Internal		External	Companies
1	IC-ISIM-LSI1	De Micheli	EXT-CEA-Valduc	EXT-Asulab
2	SB-CIME	Hébert	EXT-CSEM	EXT-Ayanda
3	SB-IPEQ-LASPE	Grandjean	EXT-ETHZ-Roesgen	EXT-Biocartis
4	SB-IPEQ-LOEQ	Deveaud-Plédran	EXT-FEMTO-ST-MIMU	EXT-Bruker
5	SB-IPEQ-LPN	Kapon	EXT-LMN-AC-Besancon	EXT-Colibrys
6	SB-IPEQ-UPKIPPE	Kippenberg	EXT-UNIGE	EXT-Debiotech
7	SB-IPMC-LNNME	Forro		EXT-Intersema
8	SB-ISIC-LCPM	Rizzo		EXT-Karmic
9	SB-ISIC-LCPPM	Vogel		EXT-Leister
10	SB-ISIC-LEPA	Girault		EXT-MicroChemical
11	STI-IBI2-LBEN	Radenovic		EXT-Nanoworld
12	STI-IBI2-LBNC	Maerkl		EXT-Rolox
13	STI-IBI2-LBO	Pioletti		EXT-Sigatec
14	STI-IEL-LANES	Kis		EXT-Silmach
15	STI-IEL-LSM	Leblebici		EXT-Icoflex
16	STI-IEL-NANOLAB	Ionescu		EXT-Synova
17	STI-IMT-ESPLAB	Farine		
18	STI-IMT-LAI	Perriard		
19	STI-IMT-LMIS1	Brugger		
20	STI-IMT-LMIS2	Gijs		
21	STI-IMT-LMIS3	Popovic		
22	STI-IMT-LMIS4	Renaud		
23	STI-IMT-LMTS	Shea		
24	STI-IMT-LO	Psaltis		
25	STI-IMT-LOA	Salathé		
26	STI-IMT-LOB	Lasser		
27	STI-IMT-LPM	Ryser		
28	STI-IMT-NAM	Martin		
29	STI-IMT-OPT	Herzig		
30	STI-IMT-SAMLAB	de Rooij		
31	STI-IMX-LC	Muralt		
32	STI-IMX-LC	Fontcuberta		
33	STI-IMX-LP	Klok		
34	STI-IMX-LTC	Månson		
35	STI-IMX-LTP	Hofmann		
36	STI-IPR-LSRO2	Clavel		
37	SV-GHI-UPKIN	McKinney		
38	SV-IBI1-LMBM1	Swartz		
39	SV-IBI1-UPDEPLA	Deplancke		
40	SV-IBI1-UPLUT	Lutolf		

VOLUME OF ACTIVITY

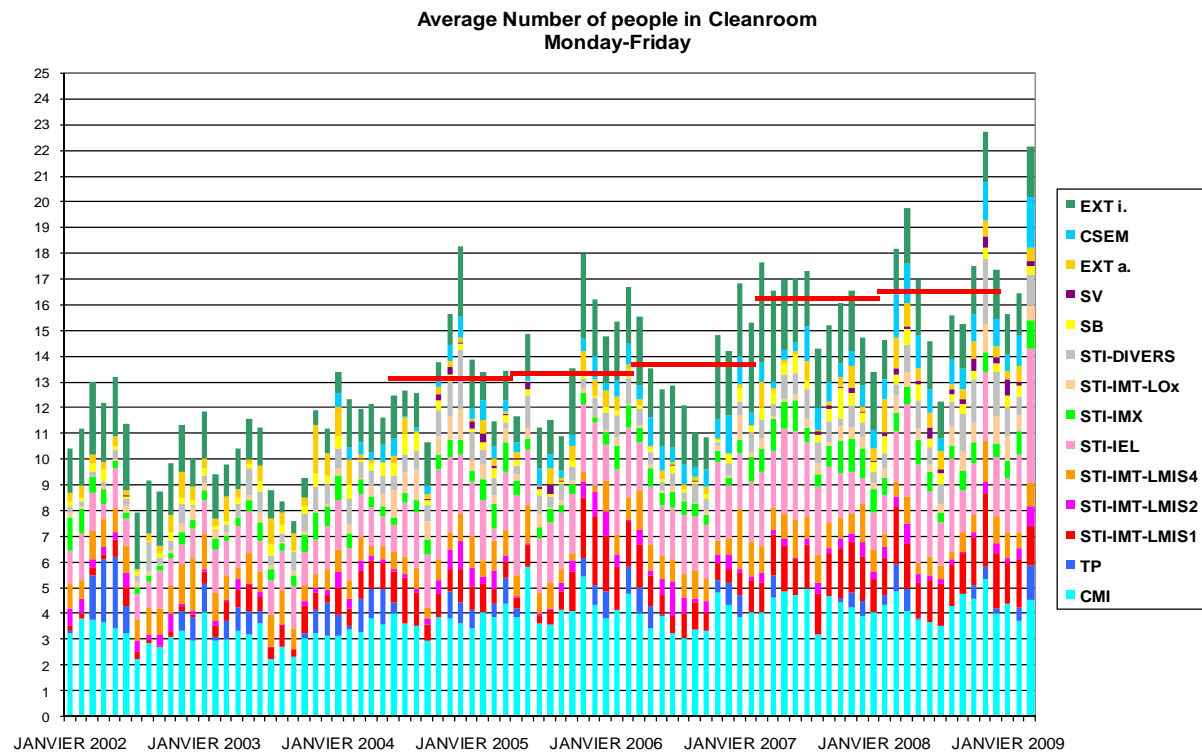
✘ Volume of activity

Amount paid by the Users



POPULATION IN THE CLEANROOM

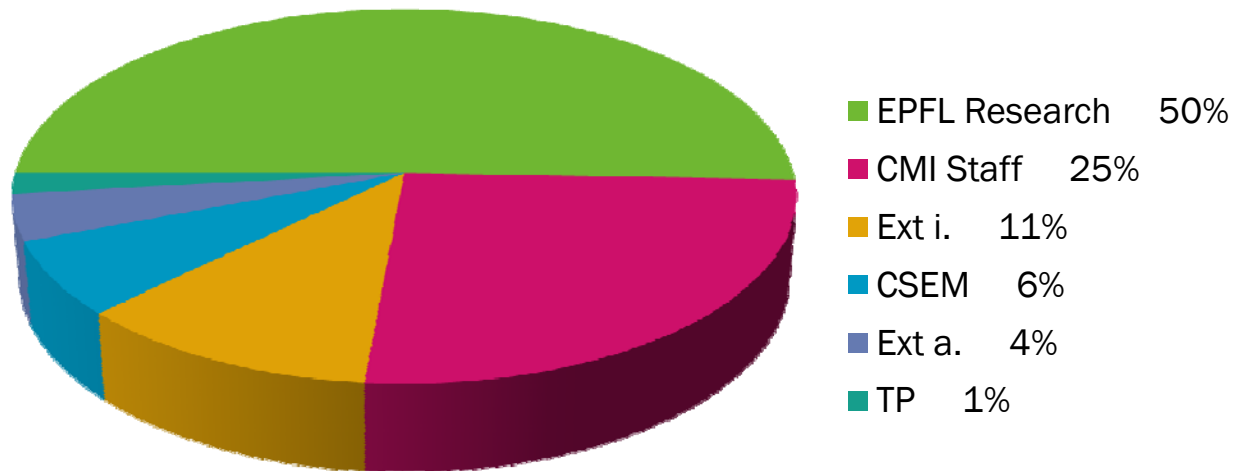
✕ Cleanroom occupancy 2002-2008



2004	13.1	people 8h/day
2005	13.3	people 8h/day
2006	13.7	people 8h/day
2007	16.2	people 8h/day
2008	16.5	people 8h/day
+2% in 2008 compared to 2007		

POPULATION IN THE CLEANROOM

Average Cleanroom Population - Year 2008



The presence of the staff in the cleanroom is a key factor for user's satisfaction and success rate !

FINANCES

✘ CMI running costs in year 2008 (kCHF)

	2006	2007	2008
Infrastructure : energy, N2, water, maintenance (covered by EPFL VPPL)	754	886	830+
Processing : consumables, maintenance of processing equipments	1'341	1'668	1'492
Salaries (covered by EPFL school of Engineering) :	1'357	1'456	1'406
TOTAL	3'452	4'010	3'728

✘ CMI resources in year 2008 (kCHF)

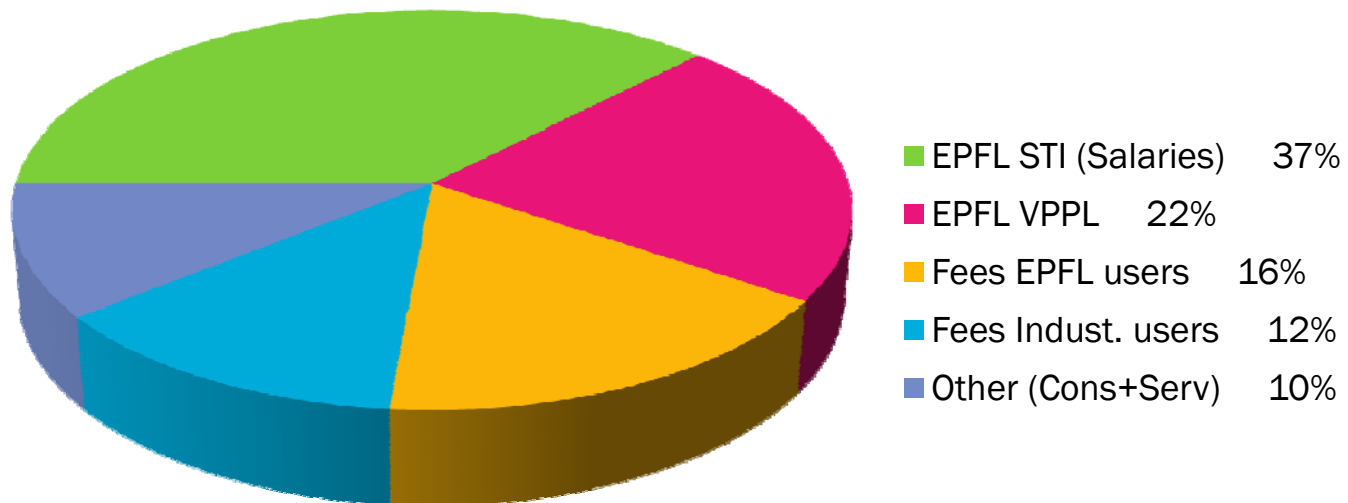
	2006	2007	2008
CMI Users' Fees (consumables) and CMI Services Revenues	1'365	1'627	1'528
TOTAL	1'365	1'627	1'528

Not included in this tables are :

- the capital expenditure
- the cost of amortization

FINANCES

Coverage of the running costs - Year 2008



FINANCES

CMI - Détail des Frais d'exploitation et des Recettes brutes Comptes de 1999 à 2008 (état au 22 avril 2009)

a) Compte dépenses du CMI (610031)		Dépenses									
No.	Rubrique	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1	Investissements urgents							-83	-70	-229	-68
2	Gaz	-19	-31	-34	-36	-26	-42	-52	-60	-89	-73
3	Photolithographie	-59	-39	-53	-51	-44	-77	-87	-94	-122	-93
4	Produits chimiques	-29	-21	-23	-30	-26	-37	-30	-22	-34	-38
5	Cibles, quartz	-16	-48	-8	-9	-11	-42	-51	-91	-39	-162
6	Plaquettes, boîtes, masques	-167	-16	-134	-170	-151	-115	-151	-180	-237	-160
7	Habillement, sécurité	-38	-16	-11	-20	-27	-31	-30	-45	-30	-43
8	Equipement informatique			-10	-53	-27	-27	-27	-49	-27	-10
9	Nettoyage habits	-13	-23	-21	-21	-20	-22	-24	-10	-28	-33
10	Entretien, consommables	-105	-250	-336	-297	-205	-400	-362	-310	-449	-441
	10.1 Entretien zone 1		-8.0	-76.7	-64.2	-61.5	-126.1	-67.0	-77.8	-59.9	-80.1
	10.2 Entretien zone 2		-21.6	-48.6	-52.2	-29.9	-17.1	-65.2	-55.2	-54.5	-57.5
	10.3 Entretien zone 3		-9.8	-32.9	-37.2	-10.5	-32.1	-61.3	-41.6	-44.4	-94.0
	10.4 Entretien zone 4		-106.6	-55.2	-30.7	-27.5	-70.4	-25.7	-37.3	-52.2	-54.8
	10.5 Entretien zone 5		-14.0	-12.7	-10.0	-22.5	-16.6	-16.9	-14.8	-51.4	-37.1
	10.6 Entretien zone 6		-2.0	-4.0	-7.7	-4.1	-7.7	-17.6	-15.5	-23.8	-12.6
	10.7 Entretien zone 7		-9.4	-37.6	-22.6	-9.2	-4.7	-44.2	-0.6	-36.9	-9.5
	10.8 Entretien infrastructures		-78.5	-68.5	-72.4	-40.2	-124.5	-55.1	-59.1	-69.6	-56.5
	10.9 Entretien FIB						-0.5	-9.4	-8.6	-33.3	-6.3
	10.10 Entretien Ebeam						0.0	0.0	0.0	-22.6	-32.9
11	Personnel temporaire	-19			-12	-65	-120	-183	-321	-292	-316
12	Total frais généraux	-28	-17	-36	-29	-43	-56	-75	-89	-91	-55
	12.1 Formation, conférences	-4.6	-4.3	-6.8	-3.1	-2.3	-1.4	-7.7	-19.2	-24.9	-14.6
	12.2 Voyages	-9.3	-0.3	-10.9	-10.3	-17.2	-21.0	-31.8	-35.2	-18.3	-10.2
	12.5 Revue annuelle. imprimés	-10.2	-8.6	-13.0	-3.9	-16.0	-10.4	-20.9	-23.0	-38.8	-23.8
	12.6 Autres frais. représentation	-3.4	-3.4	-4.9	-12.1	-7.9	-23.1	-14.3	-11.2	-9.3	-6.7
Total Dépenses CMI [kCHF]		-492	-460	-665	-714	-644	-968	-1156	-1341	-1668	-1492

FINANCES

CMI - Détail des Frais d'exploitation et des Recettes brutes Comptes de 1999 à 2008 (état au 22 avril 2009)

b) Compte recettes du CMI (520494)		Recettes									
No.	Rubrique	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
14.1	Forfait horaire interne EPFL	62	187	441	285	362	501	566	549	656	639
14.2	Forfait horaire externe académique				65	50	42	31	31	27	40
14.3	Forfait horaire externe industriel				218	157	241	426	433	564	482
14.4	Refacturation matériel interne EPFL					107	150	145	161	205	230
14.5	Refacturation matériel externe		45	70	155	35	37	49	72	82	60
14.6	Services interne EPFL					5	17	20	5	4	3
14.7	Service externe		25	23	42	65	56	107	74	69	50
15.1	Autres recettes	20	15	20	30	20	40	50	42	20	23
Total Recettes CMI [kCHF]		82	272	554	796	773	1034	1394	1365	1627	1528
TOTAL INTERMEDIAIRE [kCHF]		-410	-189	-112	82	129	66	238	25	-41	36

FINANCES

CMI - Détail des Frais d'exploitation et des Recettes brutes Comptes de 1999 à 2008 (état au 22 avril 2009)

c) Dépenses DII-E		Dépenses									
No.	Rubrique	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
SE1	Electricité procédés	-135	-139	-140	-151	-151	-156	-162	-172	-179	-184
SE2	Electricité infrastructures	-106	-79	-85	-82	-68	-71	-74	-65	-64	-63
SE3	Azote	-160	-131	-176	-206	-196	-196	-187	-185	-201	-233
SE4	Eau de ville	-78	-65	-66	-59	-62	-61	-58	-54	-74	-65
10.9	Entretien infrastructures	0	-26	-13	-35	-47	-41	-36	-36	-112	
SE5	Eau industrielle	-29	-29	-40	-37	-41	-41	-40	-47	-71	-74
SE6	Chauffage du bâtiment	-135	-135	-138	-98	-136	-130	-147	-146	-149	-171
Total Dépenses DII-E [kCHF]		-644	-603	-659	-667	-703	-696	-704	-705	-849	-791

d) Dépenses DII-I		Dépenses									
No.	Rubrique	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
9	Nettoyage de la salle blanche	-61	-61	-63	-66	-51	-46	-50	-49	-37	-39
Total Dépenses DII-I [kCHF]		-61	-61	-63	-66	-51	-46	-50	-49	-37	-39

GRAND TOTAL [kCHF]		-1116	-853	-833	-651	-624	-676	-516	-730	-928	-794
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HUMAN RESOURCES

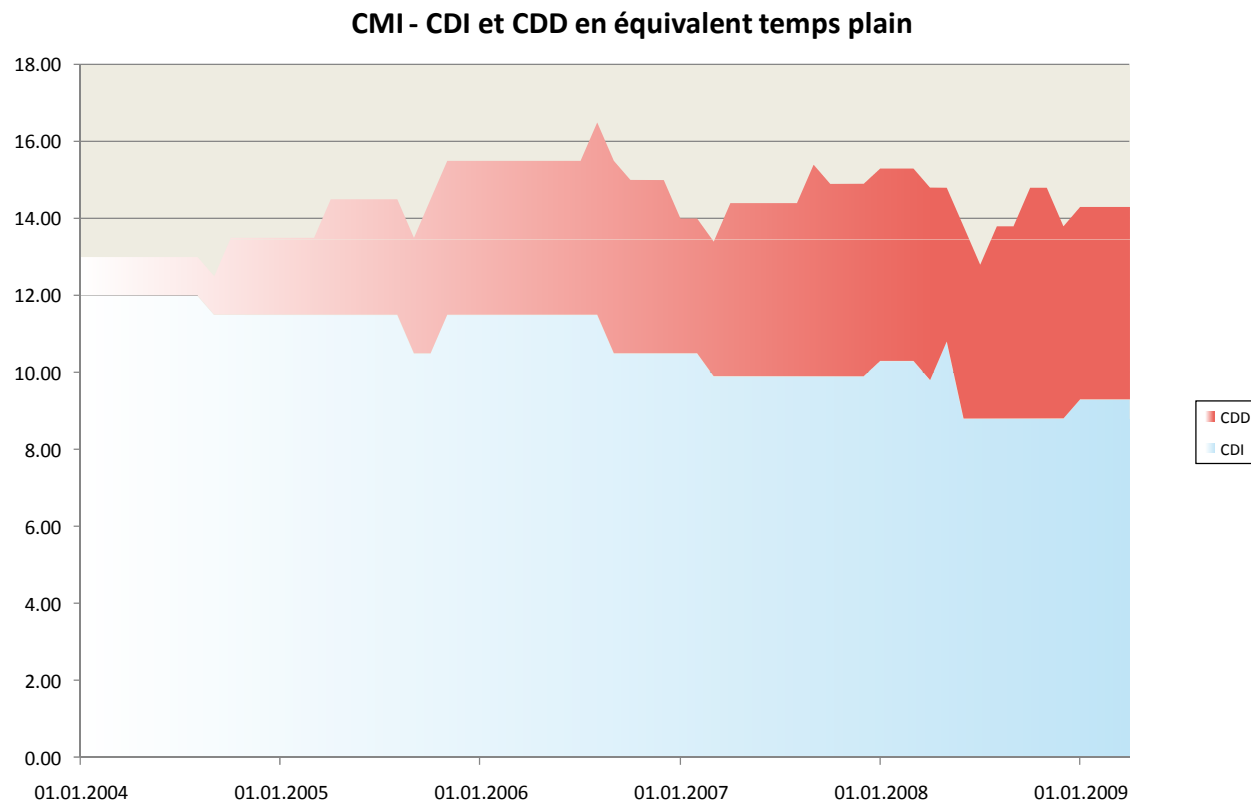
✕ Human Resources

- + 13 Full time
- + 1.5 Part time
- + 10 CDI
- + 5 CDD
- + 10 Engineers
- + 4 Technicians
- + 1 Adm. Ass.
- + 3 Learners

Philippe Flückiger	Claudia D'Agostino			Karine Challet 10.08.2011
Georges-André Racine	Jean-Baptiste Bureau 31.03.2011	Boris Lunardi 31.08.2013	Sarah Baudat 31.07.2013	
Cyrille Hibert 80%	Samuel Clabeq 30.09.2012			Laura Simon-Vermot 03.08.2012
Philippe Langlet	Didier Bouvet 50%	Guy Clerc	Yvan Deillon	Pierre-Yves Pfirter 20%
Kevin Lister				Arno Hoogerwerf CSEM
Jean-Marie Voirol	Narge Simonian 14.05.2013			Noémie Pochelon 10.08.2009

HUMAN RESOURCES

✕ Human Resources



INVENTORY

✘ Inventory 2008 in MCHF

Infrastructure	13 MCHF
Scientific Equipment	22 MCHF
Total	34 MCHF



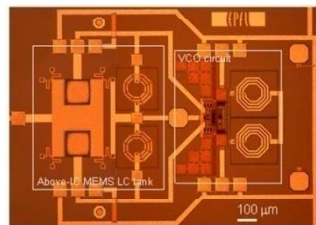
- ✘ More than 70 pieces of equipment with a very high uptime
- ✘ Several tools close to saturation

TRENDS IN MICRO- NANO- TECHNOLOGIES

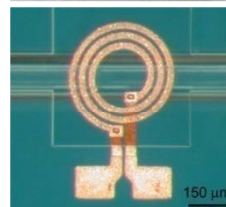
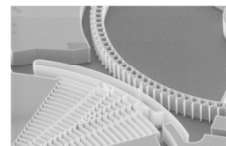
CMI tools ...



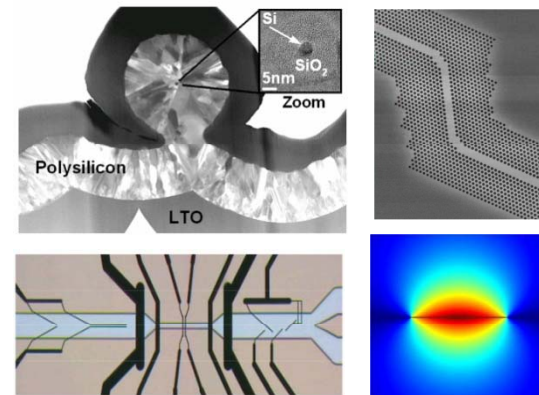
Microelectronics



MEMS

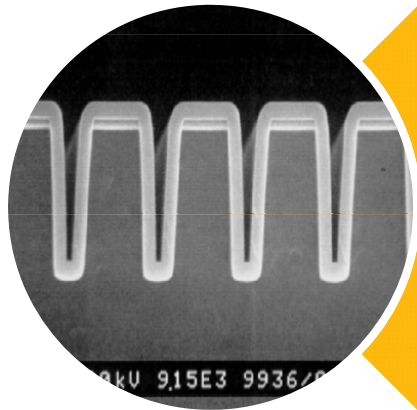


Nanotechnology



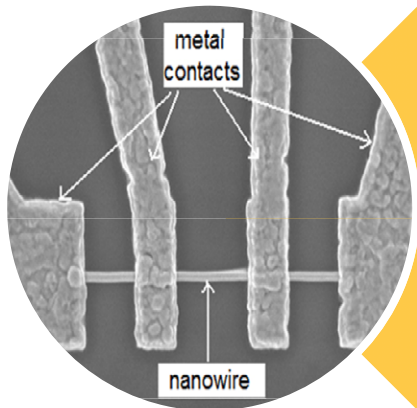
CMI projects ...

TRENDS IN MICRO- NANO- TECHNOLOGIES



New processes

- In combination with already established miniaturization processes



New materials

- New chemistry
- Bottom-up approach, self-assembly

NEEDS OF RESEARCH @ EPFL

- ✘ To allow access to broader technology need as a complement to existing CMI platform
- ✘ An additional space with « more freedom, less support »
 - + immediate access to the infrastructure
 - + permanent access (open 24/7)
 - + training on tools by experienced users
- ✘ To share these new processes/equipment in a common laboratory
- ✘ To raise common know-how between users



CMI+ CONCEPT

- ✘ To expand the CMI+ platform towards:
 - + Materials diversity (e.g. polymers, PDMS, thin films, ...)
 - + Unconventional/customized processing equipment (ALD, RIBE, Parylene, ...)
 - + Variety of new chemistries (e.g. wet etching, functionalization, ...)
 - + Lithography (dry films, thick resists, μ contact printing, ...)
 - + Non-standard substrate formats and materials
 - + General purpose metrology workstations (AFM, ellipsometry, profilometry, ...)

SAFETY

✘ Freedom will be limited by safety rules

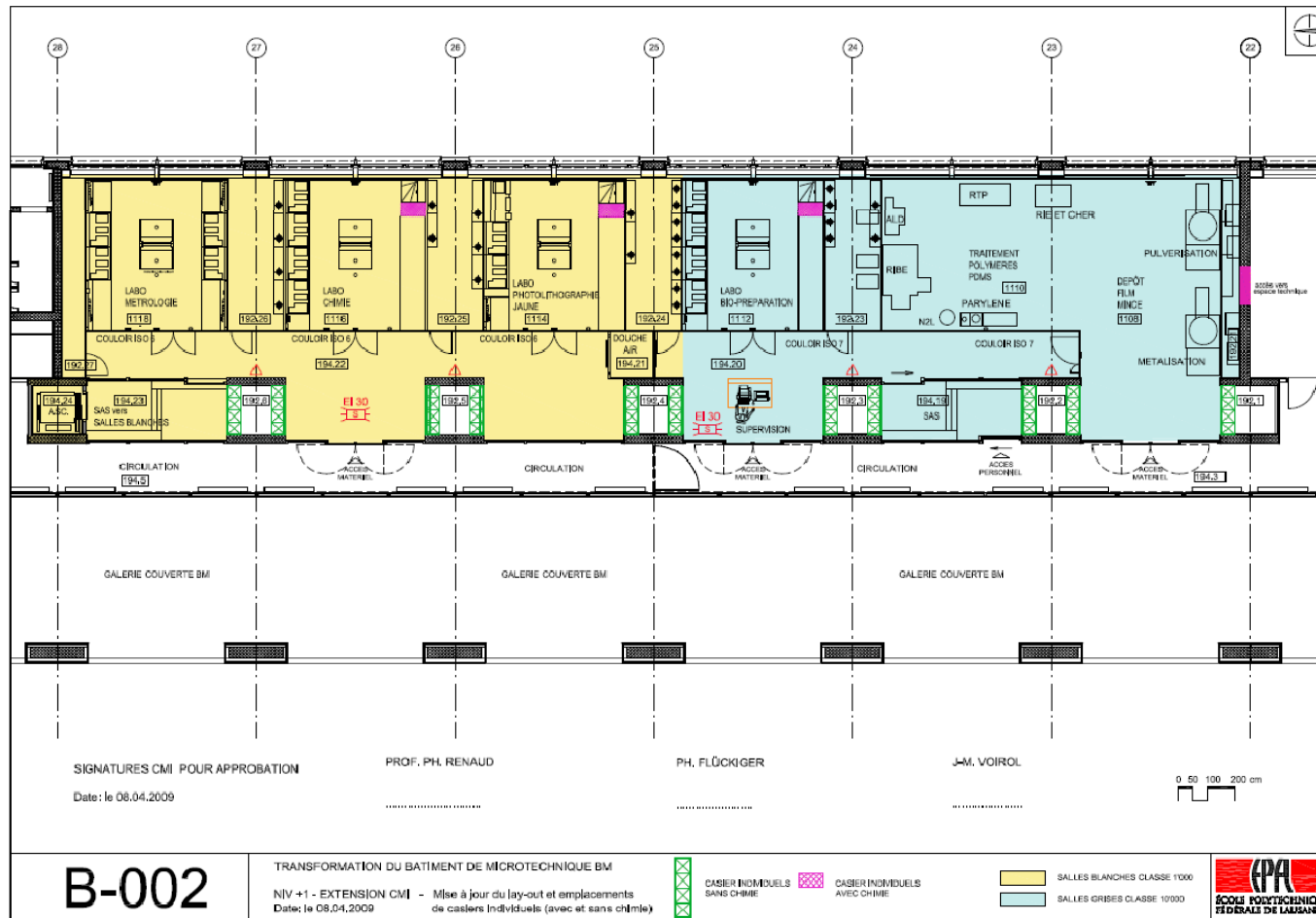


CMI
March 2009



University of Southampton
October 2005

GREY ROOM LABORATORY



CMI+ BUDGETS & AGENDA

× Budget

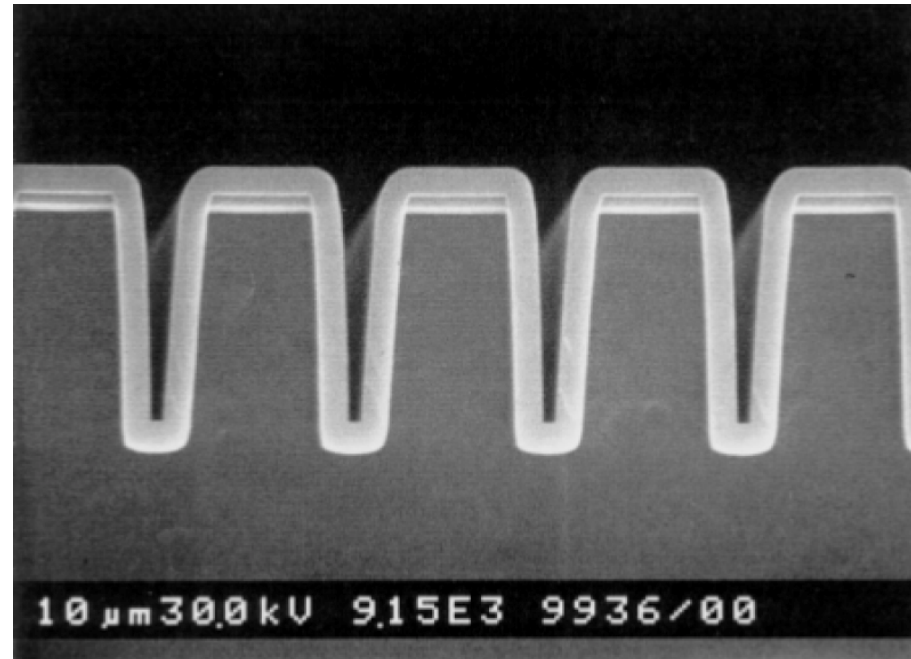
<u>Cleanroom extension</u>	7.3MCHF
<u>Scientific Equipment</u>	in discussion

× Agenda

Appel d'offres en entreprise totale	18.11.2008
Délai de clôture	30.01.2009
Contrat	May 2009
<u>Exécution de l'ouvrage</u>	2010

CMI+ TOOLS

- ✗ ALD !
- ✗ AFM !
- ✗ Wet benches
- ✗ Photolithography
- ✗ Thin films
- ✗ Metrology
- ✗ Ion Milling ?
- ✗ Grinding ?
- ✗ ... + *other needs form the USERS !*



CMI+ SUMMARY

- ✘ New shared laboratory space for micro and nanotechnology research
- ✘ Response to the evolution towards new technologies and materials
- ✘ Opportunity for: life sciences, materials, nano-sciences,..
- ✘ Flexible use, easy access, lower running cost
- ✘ Continuity to existing clean room facilities
- ✘ Grey room infrastructure and wet labs investments included in BM rehab budget
- ✘ Scientific equipments: flexible and versatile, complementary to existing CMI equipments
- ✘ Valorization of the actual cleanroom with bottlenecks solving and space usage optimization

CONCLUSIONS

- ✘ Since its opening in 1999, CMI has constantly increased its volume of activity
- ✘ CMI is taking all the possible actions to accommodate the research and educational needs of the EPFL community



EPFL MICRONANOFABRICATION ANNUAL REVIEW MEETING

PROGRAM

- × 10h20-10h40 Andrea Urban (<http://www.bosch.de>), MEMS microstructuring technologies and product applications
- × 10h40-11h00 Tobias Kippenberg (<http://www.mpg.de/k-lab>), Cavity optomechanics at the micro- and nanoscale
- × 11h00-11h20 Emmanuel Delamarche (<http://www.zurich.ibm.com>), Patterning proteins at the micro- and nanoscale or how not to fry an egg
- × 11h20-11h45 Break
- × 11h45-12h00 Aleksandra Radenovic (<http://lben.epfl.ch>), Nanoscale probes and platforms for biology
- × 12h00-12h15 Daniel Grogg (<http://nanolab.epfl.ch>), Vibrating body transistors
- × 12h15-12h30 Paul Vescovo (<http://www.silmach.com>), Towards nanomechanics
- × 12h30-14h00 Lunch & Poster Session
- × 14h00-14h15 Reinhard Voelkel (<http://www.suss.ch>), Micro-optics on wafer-level: manufacturing and applications
- × 14h15-14h30 Danick Briand (<http://samlab.epfl.ch>), Environmental sensors on plastic foil for logistics applications
- × 14h30-14h45 Nicolas Durand (<http://lmis4.epfl.ch>), Protein transport phenomena in nanofluidic channels
- × 14h45-15h00 Break
- × 15h00-15h15 Alex Dommann (<http://www.csem.ch>), Quality insurance in MEMS production
- × 15h15-15h30 Yuksel Temiz (<http://lsm.epfl.ch>), Exploring the 3rd dimension in integrated systems - Examples of recent results achieved in CMI
- × 15h30-15h45 Nicolas Abelé (<http://www.lemoptix.com>), MEMS scanning mirror for micro-projection application
- × 15h45-17h00 Cocktails & Poster Session

3 invited talks

9 talks involving CMI or CSEM

ENJOY THE CONFERENCE

- ✘ In 2007 both Andrea URBAN and Franz LAERMER were awarded with the prize "European Inventor of the Year" by the European Patent Office and the EU Commission, for the joint invention and successful development of the "Bosch DRIE process".

