Grenoble INP
ACCÉLÉRATEUR D'AVENIRS
SPRINGBOARD TO THE FUTURE

POLITECNICO DI TORINO
1859 1906

EPFL
ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Lab Works at Grenoble: Overview and Organization

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Master Nanotech

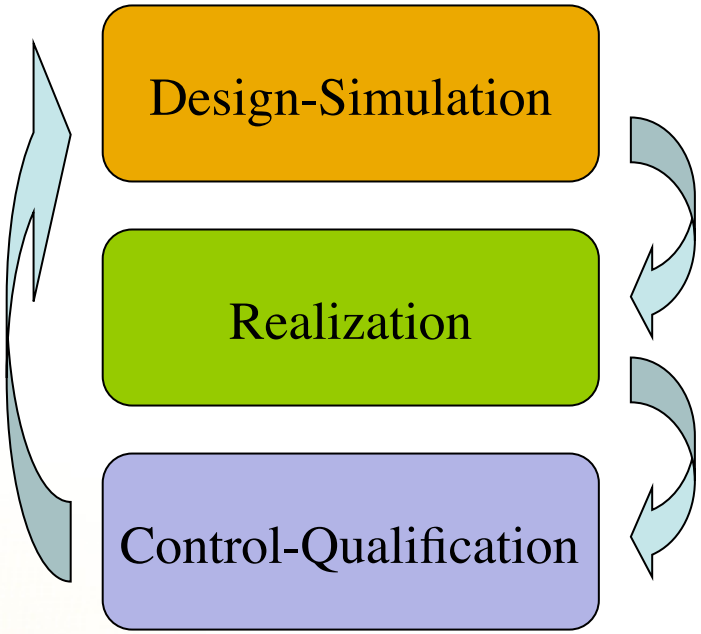
GRENOBLE INSTITUTE OF TECHNOLOGY

Outline

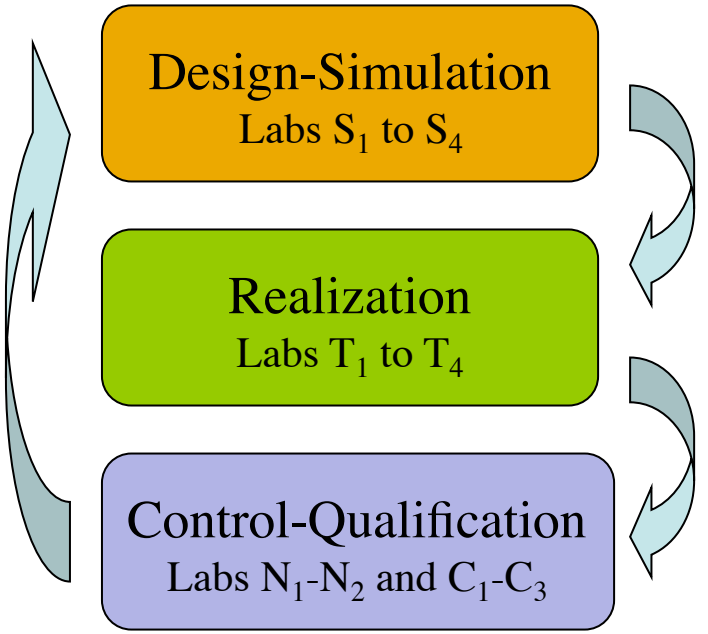
- Objectives
- Organization
  - Study logic
  - Breakdown structure
  - Schedule
  - Where? When?
- Evaluation

Labs Objectives

- Device manufacturing flow:

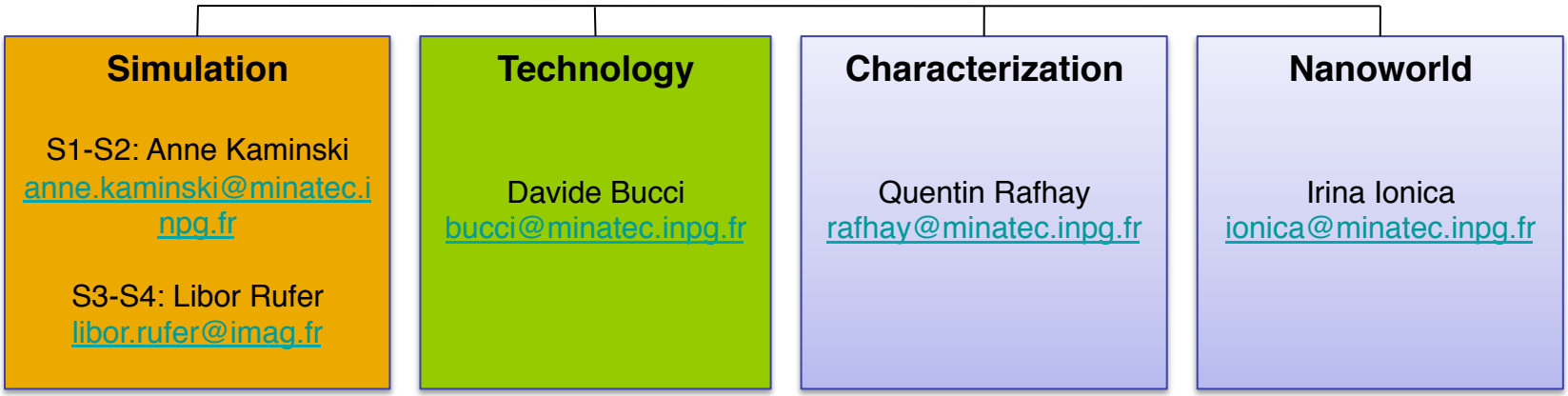


- Lab-work organization:



Organization

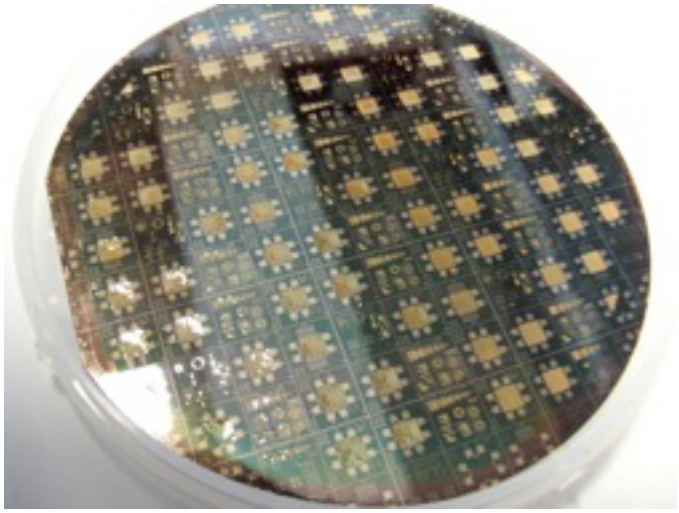
- Contacts:



- Labs rules:
  - Attendance to the labs is mandatory!
    (unjustified absence <=> score reduction)
  - Sessions start on time (8 AM or 13 PM)
  - Technical staff rules…

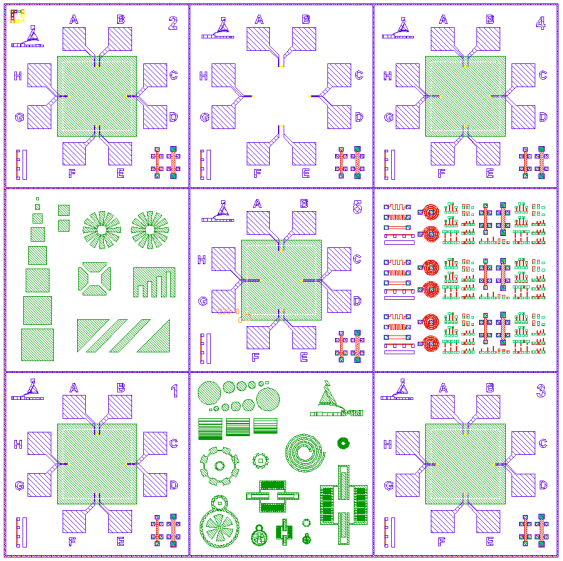
All for one chip, one chip for all

- Wafers:



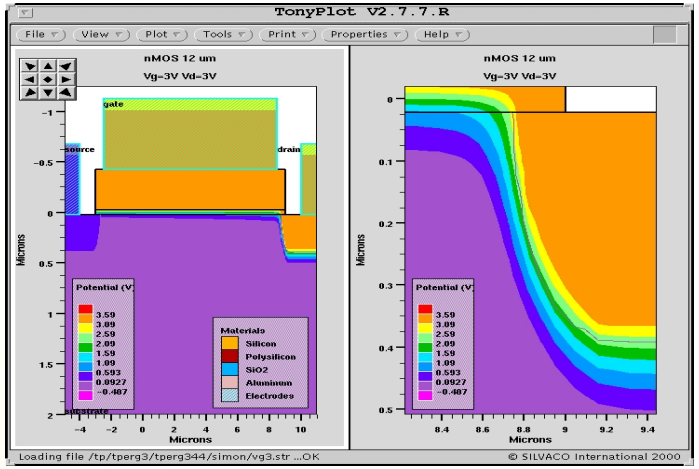
  - 4-inches SOI or Si
  - CMOS and MEMS devices

- Chip layout:

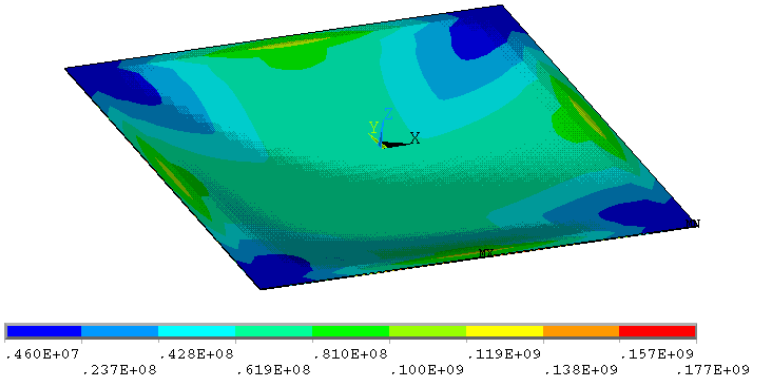


S_1-S_4: Simulation sessions

- S_1: technological sim.
  - Athena software
- S_2: electrical sim.
  - Atlas software



- S_3-S_4: electro-mechanical simulation
  - ANSYS software
  - Course L. Rufer (MEMS)



T_1-T_4: Clean-room sessions

- Work in a clean room:
  - Dedicated suits

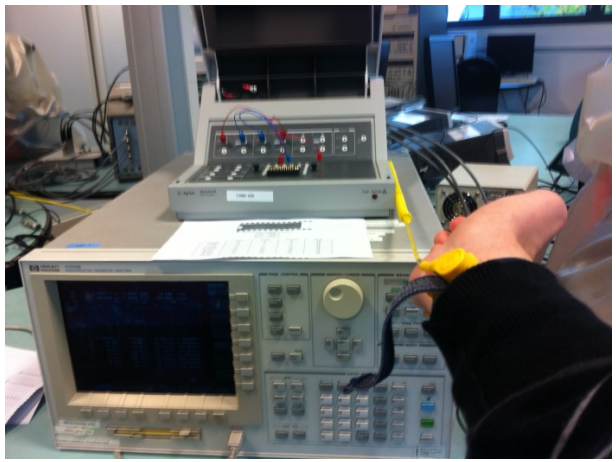
  - Trousers and T-shirt
  - Strict respect of the **safety procedures**
  - Bring an USB key

- MEMS-CMOS proc. flow:

  - Double-side photolithography, deep RIE, ion implantation, oxidation, etc…

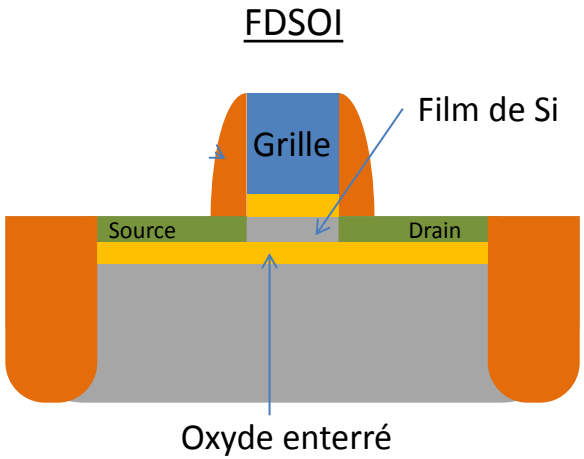
C_1-C_3: Characterization sessions

- $C_{1\text{-}2}$: CMOS caract.



Standard industrial measurements

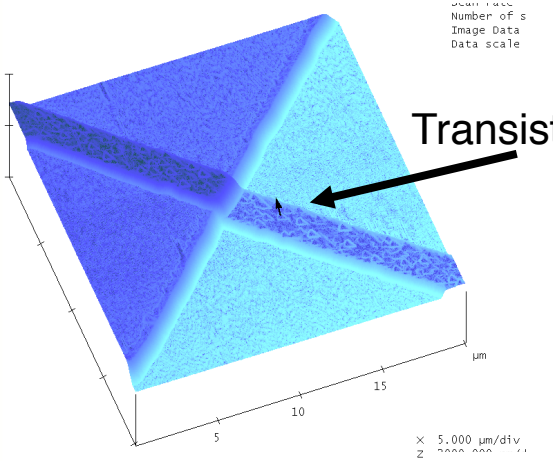
- C_3: FDSOI



Advanced techniques

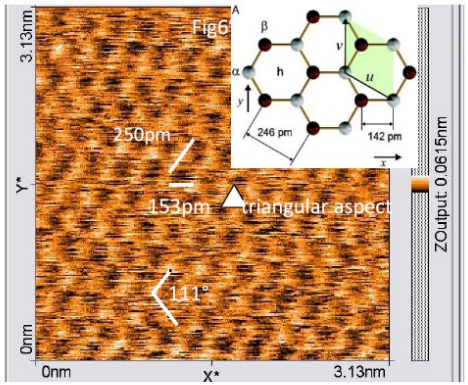
N_1-N_2: Nanoworld sessions

N_1: STM, contact mode AFM

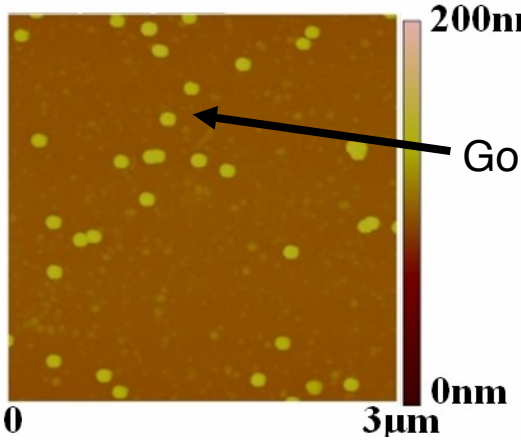


Transistor gate

Graphite atomic structure

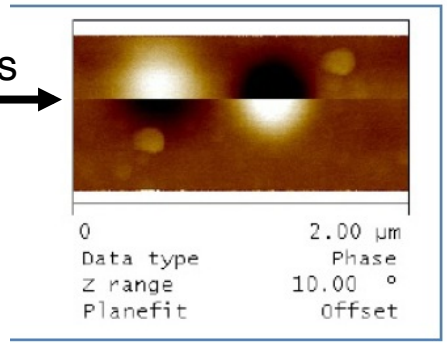


N_2: Tapping mode AFM, EFM



Gold nanoparticles

Charging effects



Planning

			G1		G2		G3		G4		G5		G6		G7		G8		G9		G10	
Wed	04/02/15	AM	S1	AK	S1		S1										N1	II				
Wed	04/02/15	PM	S2	AK	S2		S2				project						N2	II				
Thur	05/02/15	PM	S3	LR	S3		S3				project				project				project			
Wed	11/02/15	AM	T1	DB	T1	QR			S1	AK	S1		S1		project				N1	JCh		
Wed	11/02/15	PM	T2	DB	T2	QR	project				project				project				N2	JCh		
Mon	23/02/15	AM	S4	LR	S4		S4		S2	AK	S2		S2		Bio1				project			
Wed	25/02/15	AM	T3	DB	T3	QR	N1	JCh	S3	LR	S3		S3		S1	AK	S1		S1		S1	
Wed	25/02/15	PM	T4	DB	T4	QR	N2	JCh	S4	LR	S4		S4		S2	AK	S2		S2		S2	
Mon	02/03/15	PM	C1	LP	C2		project						Communication at work									
Wed	04/03/15	AM	project				T1	DB	T1	MB			N1	LB	S3	LR	S3		S3		S3	
Wed	04/03/15	PM	C2	LP	C1		T2	DB	T2	MB			N2	XM	S4	LR	S4		S4		S4	
Mon	09/03/15	PM	Communication at work														Bio2		project			
Wed	11/03/15	AM	C3	IBA			T3	DB	T3	MB	N1	LB			project				project			
Wed	11/03/15	PM			C3	IBA	T4	DB	T4	MB	N2	XM							project			
Wed	18/03/15	AM	project				C1	LP	C2		T1	Aku	T1	AK	N1	LB			Bio1			
Wed	18/03/15	PM	project				C2	LP	C1		T2	Aku	T2	AK	N2	XM			Bio2			
Wed	25/03/15	AM					C3	MB			T3	Aku	T3	AK	project						N1	LB
Wed	25/03/15	PM	project						C3	MB	T4	Aku	T4	AK	Bio2						N2	XM
Wed	01/04/15	AM	project				project				C1	IBA	C2		T1	MB	T1	AK	Communication at wo			
Wed	01/04/15	PM	Communication at work								C2	IBA	C1		T2	MB	T2	AK	project			
Wed	08/04/15	AM	N1	SC			project				C3	MB			T3		T3	AK	Communication at wo			
Wed	08/04/15	PM	N2	XM			project						C3	MB	T4		T4	AK	Communication at wo			
Wed	22/04/15	AM									Communication at work								T1	MB	T1	AK
Wed	22/04/15	PM	Communication at work								project				C1	IBA	C2		T2	MB	T2	AK
Wed	29/04/15	AM	Communication at work								project				project				T3		T3	AK
Wed	29/04/15	PM					project				project				C2	MB	C1		T4		T4	AK
Wed	06/05/15	AM	Communication at work												project				C1	IBA	C2	
Wed	06/05/15	PM			N1	SC					Communication at work								C1	IBA	C2	
Tues	12/05/15	AM			N2	XM	project								C3	IBA			project			
Wed	13/05/15	AM	project						N1	SC	project						C3	IBA	Communication at wo			
Wed	13/05/15	PM	project						N2	XM	Communication at work								C3	IBA		
Wed	20/05/15	AM									Communication at work										C3	IBA
Wed	20/05/15	PM	BULATS 14h00-16h00																			

First session:
February 4, AM

Tight schedule!

Where and when?

- **S_1-S_4:** e. hall BCA-I building
- **T_1-T_4:** e. hall BCA-I building
- **N_1-N_2:** e. hall BCA-I building
- **C_1-C_3:** e. hall BCA-I building

ALL: 8 AM or 13 PM

Handouts

- Clean room (T1-T4)
  (clean room paper)
  - Questions about the process flow
  - Process flow slides
  - Wafer page
- C, S and N:
  (normal paper)
  - C1-C3
  - S1-S2
  - N1-N2

Evaluation

T, C, N: a single oral examination session in front of a jury (2 professors).

"Explain how you ensure that the rinsing of your samples is complete. Does this method work equally well for acids, bases and solvents?"

Notes taken on the handouts are considered in the mark (laboratory notebook)

S: a single 3-5 pages report

Final mark = oral (T, C, N) 75% + report (S) 25%

Unjustified absence: -2 points on final mark

Evaluation and reporting

- Session reporting rules:
  - Fixed and communicated by each session professor.
- Reports (max 15 pages)
- S3-S4: course L. Rufer

- Evaluation:
  - For each session:
    Reports and participation
    Unjustified absence:
    -2 points per 4h lab
- Final mark:

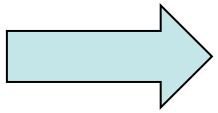
$$FM = \frac{4T_{1-4} + 2S_{1-2} + 3C_{1-3} + 2N_{1-2}}{11}$$

Reports

	Groups of	Preparation	Deadline
T, C	4	Read the documents	2 weeks after the final session
S1-S2	2	Read the documents	2 weeks after the final session
N	2	Read the documents, **do the calculations**	At the end of each session

Conclusion

- Four categories of labs in CIME-MINATEC:
  - Simulation
  - Technology
  - Characterization
  - Nanoworld



Complete Micro-nanotech process flow

- State-of-the-art tools and procedures
- One contact person assigned per lab type
- In case of problems, warn us **in time**!