Labs work @ Phelma

PHELMA 4PMTMNL2 TP : Micro and Nanosystems (4 ECTS)

- Objectives
- Organization
  - *Study logic*
  - *Breakdown structure*
  - *Schedule*
  - *Where? When?*
- Assessment

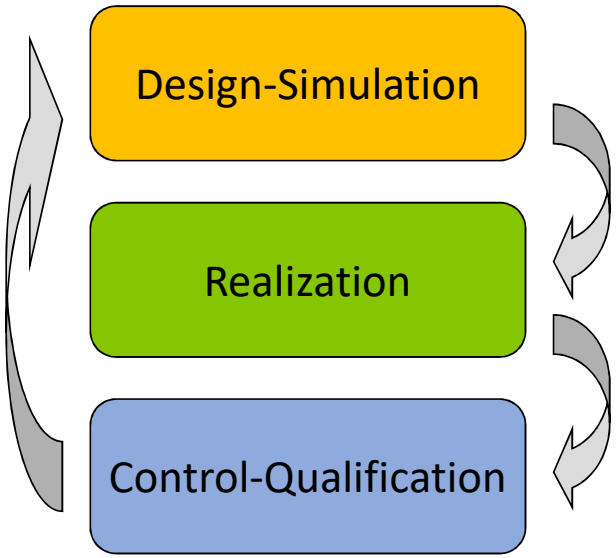
40h / student

12 professors involved

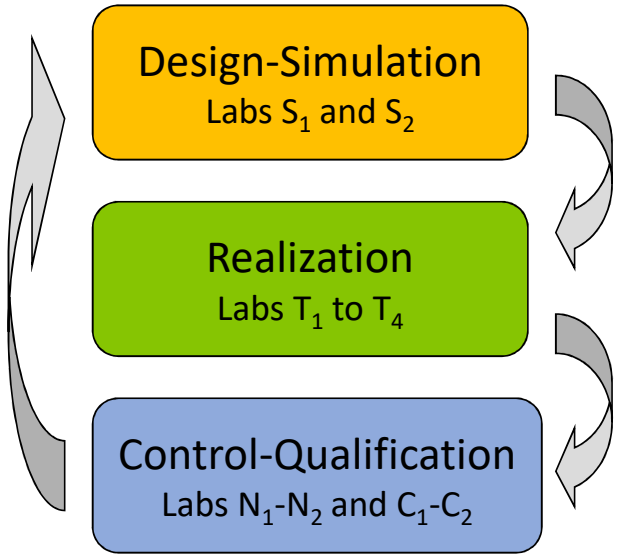
Technical support from CIME Nanotech

Objectives

- Device manufacturing flow



- Lab-work organization



Organization

SIMULATION

S1
S2

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TECHNOLOGY

T1
T2
T3
T4

aurelien.kuhn@grenoble-inp.fr

CARACTERISATION

C1
C2

maryline.bawedin@grenoble-inp.fr

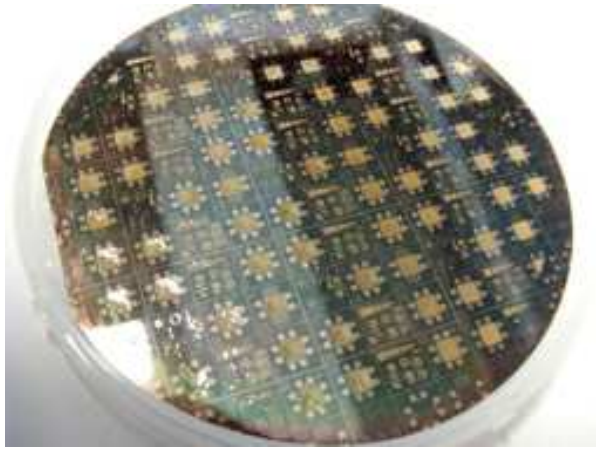
NANOWORLD

N1
N2

clemens.winkelmann@grenoble-inp.fr

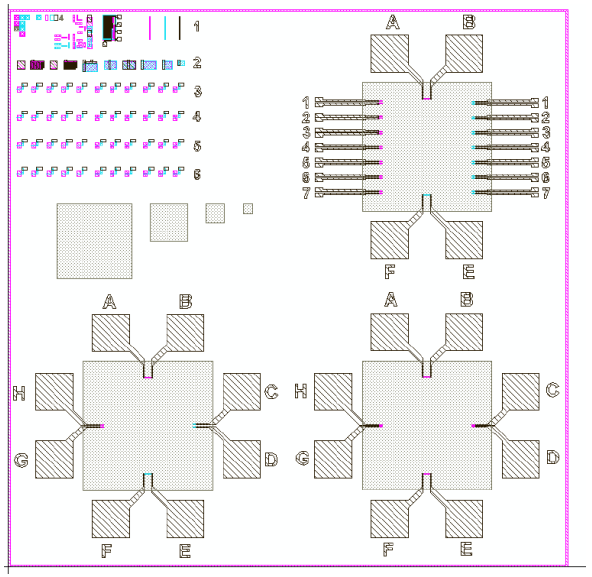
All for one chip, one chip for all

- Wafers:



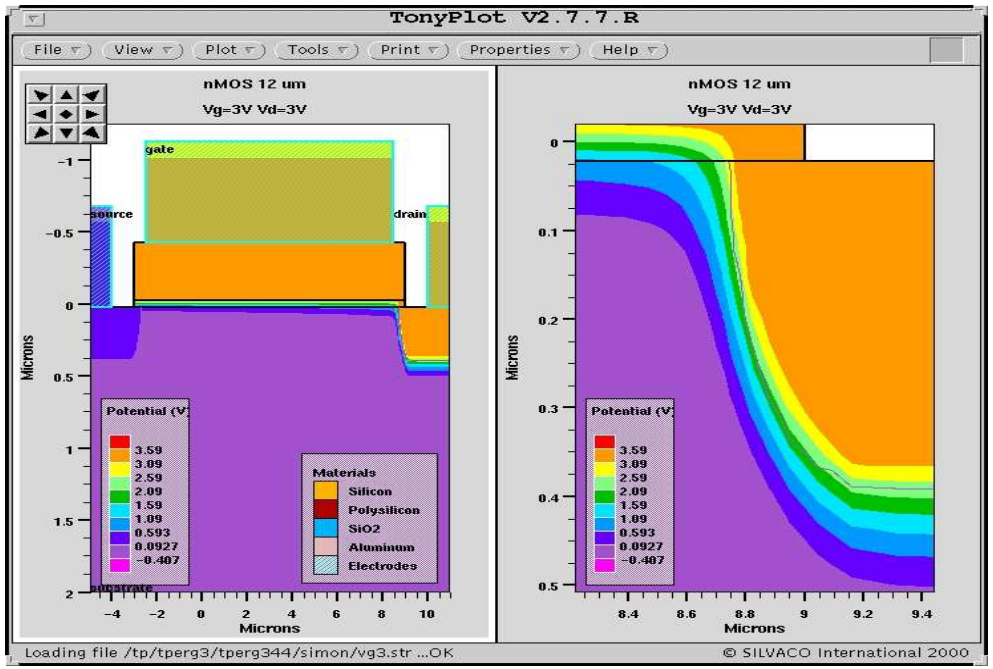
- 4-inches Si
- MOS tr. and MEMS

- Chip layout:



S_1-S_2: Simulation sessions

- S_1: technological simulation
  Athena software
- S_2: electrical simulation
  Atlas software



Anne Kaminski
anne.kaminski@grenoble-inp.fr

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 memory stick

- MEMS-CMOS proc. flow:

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

D. Bucci

L. Montes

M. Bawedin

JE. Broquin

A. Kaminski

A. Kuhn

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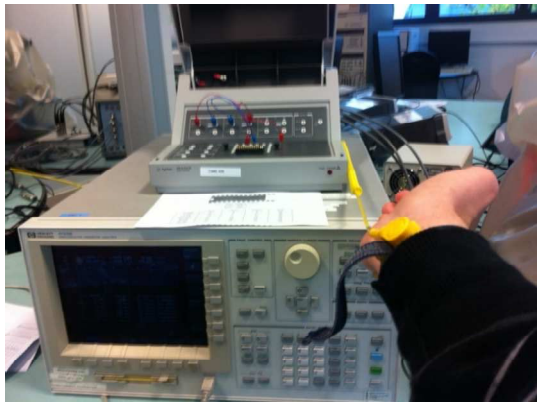
Safety!

Clean room is a chemistry environment so :

- **covered arms and legs, covered stable shoes, no make-up, no jewels, no loose hair… and anything that is not compatible with a clean room suit.**
- **No contact lenses.**
- **Do not touch your face with your gloves !**
- **Strictly follow the security procedure explained by your teacher at the beginning of the session.**
- **If you pick up a red telephone, DO NOT hang up by yourself, tell the security guy it is a mistake and wait him to tell you to hang up.**

C_1-C_2: Characterization sessions

- $C_{1\text{-}2}$: CMOS characterization



Maryline BAWEDIN

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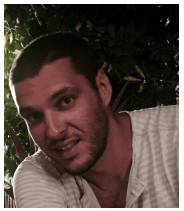
Théano KARATSORI

Standard industrial measurements

N1-N2: Nanoworld sessions

T. Ouisse

S. Le Denmat



J. Coraux

F. Marchi

clemens.winkelmann@grenoble-inp.fr

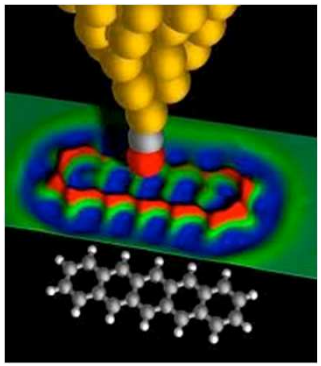
"Scanning Probe Microscopy"

Description: Learn and understand different scanning probe microscopy methods for local inspection of surfaces and devices.

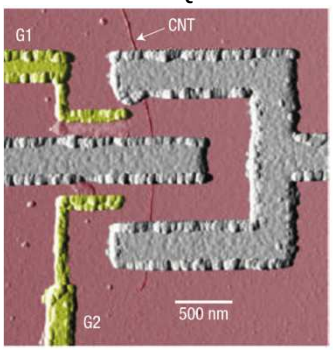
Why this course in the Nanotech training?
SPM is an essential ingredient in Nanotechnology and Nanoscience, for visualizing nano-objects, but also for manipulating them.

Linked with Advanced Microscopy lecture

AFM single molecule mapping

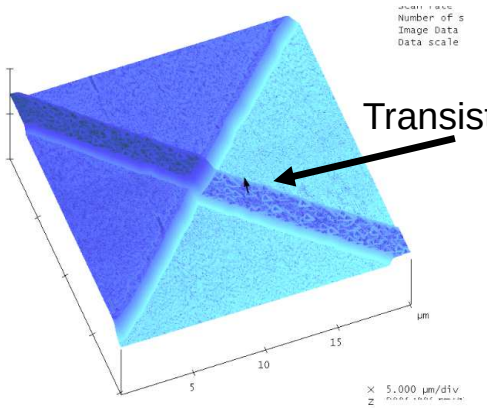


CNT SQUID

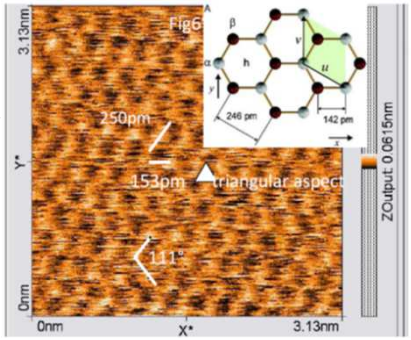


N1-N2: Nanoworld sessions

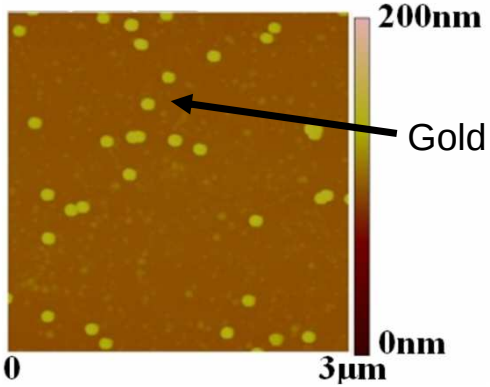
N_1: STM, contact mode AFM



Graphite atomic structure

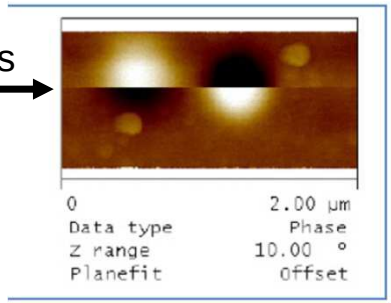


N_2: Tapping mode AFM, EFM



Gold nanoparticles

Charging effects



Timetable

First session:
February 5th am

			G1		G2		G3		G4		G5		G6		G7		G8		G9		G10	
Wed	05/02/20	AM	N1	SLD							S1	AK	S1	AK	S1	AK	S1	AK				
Wed	05/02/20	PM	S1	AK	S1	AK	S1	AK	S1	AK	N1	CW										
Thurs	06/02/20	PM	S2	AK	S2	AK	S2	AK	S2	AK	N2	TO										
Wed	12/02/20	AM	T1	DB	T1	JEB	N1	CW			S2	AK	S2	AK	S2	AK	S2	AK				
Wed	12/02/20	PM	T2	DB	T2	JEB	N2	TO	Communication at work													
Thurs	13/02/20	PM	N2	SLD					Communication at work													
Wed	19/02/20	AM	T3	DB	T3	JEB			Communication at work										Project			
Wed	19/02/20	PM	T4	DB	T4	JEB	Project															
Wed	04/03/20	AM	C1	MB	C2	MB	T1	JEB	T1	LM					N2	SLD			S1	AK	S1	AK
Wed	04/03/20	PM	C2	MB	C1	MB	T2	JEB	T2	LM					N1	FM			S2	AK	S2	AK
Thurs	05/03/20	PM			N1	FM																
Wed	11/03/20	AM	Communication at work								T1	MB	T1	JEB			N1	SLD	Communication at w			
Wed	11/03/20	PM	Project								T2	MB	T2	JEB			N2	JC	Project			
Wed	18/03/20	AM	Project				T3	AK	T3	LM	Project								N1	CW	Project	
Wed	18/03/20	PM			N2	TO	T4	AK	T4	LM	Project											
Thurs	19/03/20	PM	Communication at work						N1	FM	Project								ommunication at wo			
Wed	25/03/20	AM					C1	TK	C2	TK	T3	AK	T3	DB	Project				N2	JC	Project	
Wed	25/03/20	PM	Project				C2	TK	C1	TK	T4	AK	T4	DB	Project							
Wed	01/04/20	AM	Project						Communication at work										T1	AK	T1	JEB
Wed	01/04/20	PM	Project						N2	SLD	Project								T2	AK	T2	JEB
Wed	08/04/20	AM	Project								C1	TK	C2	TK	Project				T3	MB	T3	JEB
Wed	08/04/20	PM	Project								C2	TK	C1	TK	Project				T4	MB	T4	JEB
Wed	29/04/20	AM	Project										N1	CW	T1	AK	T1	JEB	C1	TK	C2	TK
Wed	29/04/20	PM	Project										N2	JC	T2	AK	T2	JEB	C2	TK	C1	TK
Wed	06/05/20	AM	Communication at work						Project						T3	MB	T3	JEB	ommunication at wo			
Wed	06/05/20	PM							Projet						T4	MB	T4	JEB			N2	JC
Thurs	07/05/20	AM							Communication at work													
Thurs	07/05/20	PM	Communication at work												C1	TK	C2	TK	ommunication at wo			
Wed	13/05/20	AM													C2	TK	C1	TK			N1	CW
Wed	13/05/20	PM	Communication at work																ommunication at wo			

MaJ	27/01/2020	
Prenom	Nom	Code
Simon	Le Denmat	SLD
Marylin	Bawedin	MB
Davide	Bucci	DB
Clemens	Winkelmann	CW
Anne	Kaminski	AK
Laurent	Montes	LM
JE	Broquin	JEB
Johann	Coraux	JC
Florence	Marchi	FM
Thierry	Ouisse	TO
Theano	Karatsori	TK

Where and when?

- **S_1-S_2:** 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_2:** e. hall BCA-I building

ALL: 8 AM or 13 PM, **BE ON TIME!**

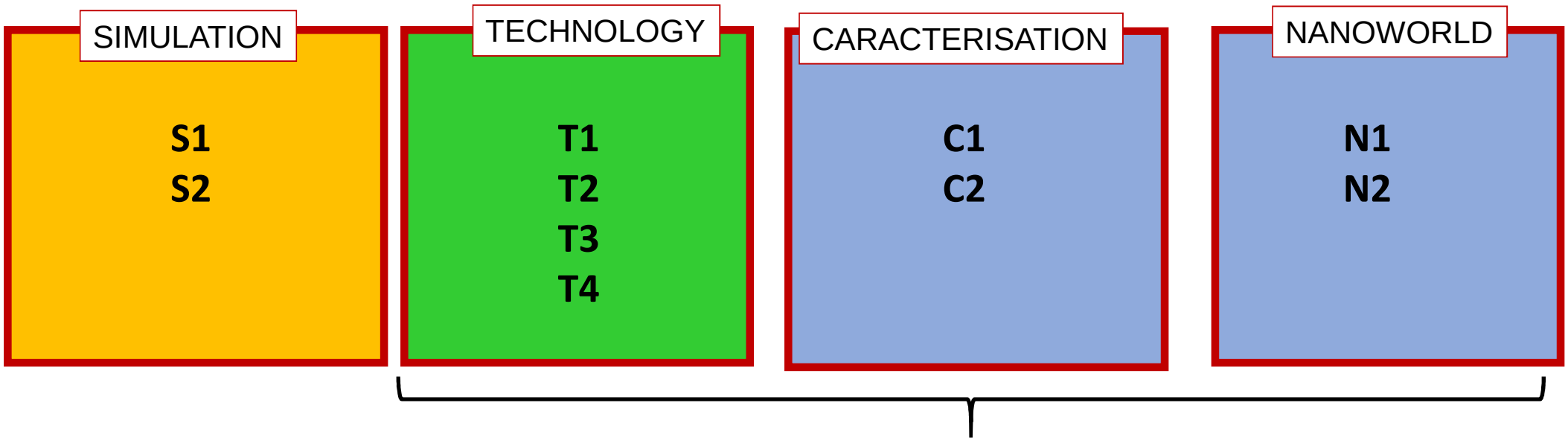
Attendance mandatory…. impossible to redo or shift the practical

Documents: chamilo

PHELMA 4PMTMNL2 TP : Micro and Nanosystems

- Clean room (T1-T4)
  - Questions about the process flow
  - Process flow slides
  - Wafer page
- C, S and N:
  - C1-C2
  - S1-S2
  - N1-N2

Assessment



Written report

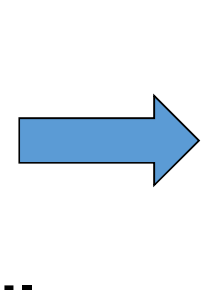
20% score

Written exam (2h)

80% score

Conclusion

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



Complete Micro-nanotech process flow

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