

EduNano project

CIME Nanotech final report

Introduction

CIME Nanotech as a partner involved in the EduNano project contributed by providing two video recorded lectures in the field of Spintronics and Nanobiotechnologies. In addition, CIME Nanotech offered four one week lab sessions organized in July 2016 and December 2016.

Spintronics

Since the discovery of giant magnetoresistance, research activity in spintronics is evolving extremely fast and many applications have been developed such as magnetic sensors, read heads, magnetic memories, magnetic logic devices, microwave components. A major trend of spintronic devices is the continuously decreasing size of the active part combined with an increasing operation frequency (nanosecond and below). The course covered spintronics from basic knowledge to working principles of several applications, describing fabrication and characterization technics. Knowing how the magnetic behaviour is affected by device scaling and how to control magnetization is the key-issue for developing new applications or optimizing those already existing.

The lecture has been set up by Professor Liliana Buda-Prejbeanu with the help of two course lecturers, Mair Chshiev and Ursula Ebels. In order to follow this course, students need some prerequisites, namely basics in solid state physics, quantum mechanics, electromagnetism and magnetism.

At the end of the courses, students should be able to:

- Understand the basics of magnetic materials and building blocks of a magnetic device
- Know the basic properties of magnetic nanostructures
- Use the LLG equation to understand the control of magnetization
- rigorously analyse the scientific literature
- Know the basic principles of various applications (sensors, memories, oscillators)

Nanobiotechnologies

Nanobiotechnology is a new and vast domain, which is intrinsically multidisciplinary: first because at this scale, combined chemical and physical properties provide new functions; second because living cells and

organisms are sensitive to molecules and molecule assemblies from the nano- to the microscale. The possibility to engineer objects with such resolution gives the opportunity to strongly influence biological phenomena, for the best and the worse. It is therefore essential to provide a good overview of the possibilities and the difficulties of these technologies, using examples of ongoing research activities. In this way, the student will develop his/her imagination and be ready to seize new opportunities from his own work.

The lecture has been set up by the Professor Franz Bruckert with the help of several course lecturers, Marianne Weidenhaupt, Didier Delabouglise, Catherine Picart, Didier Gasparutto, Charlotte Vendrely, Dominique Bourgeois, Valerie Stambouli. The course prerequisites are a basic knowledge of biological macromolecules (DNA, RNA, proteins) and of genes (gene structure, promoter, transcription, translation, splicing). Moreover, a knowledge of prokaryote and eukaryote cell culture and of the control of gene expression (transcription factors, histones) is a plus.

Upon a successful completion of this course students should be able to:

- Understand the basics of protein engineering
- Use fluorescent molecules
- Know the basic properties of nanoparticles and how to functionalize, characterize and handle them
- Know how to prepare bioactive surfaces and to characterize them
- Know the basic principles of most biosensors
- Critically read the scientific literature about possible applications of nanoparticles and bioactive surfaces in biology and medicine

Laboratory practices organized at CIME Nanotech, Grenoble, France

First session

CIME Nanotech in Grenoble hosted students from the partner Israeli universities in the framework of Edunano project. From July 7th to July 12th, 25 students and a faculty member from Technion, the Weizmann Institute, Tel Aviv University, Bar Ilan University, the Hebrew University of Jerusalem and Ben Gurion University attended practical works on our facilities. Two main themes were proposed within this program:

- MOS transistor manufacturing, with practices on clean room processes, processing technology simulation and MOS transistor electrical characterization (2 groups of 8 students).
- Nano-biotechnology labs, with practices on DNA extraction from a bacteria, DNA labeling by fluorescence, DNA hybridization on an oligonucleotide and AFM manipulation, which can also be used on biological materials (1 group of 10 students).

Ten faculty members from the University Grenoble Alpes and the Grenoble Institute of Technology were involved in these classes. Students really appreciated their professionalism and expressed their individual feeling, such as that of Tony Y. from Baryan University: *"We get to know amazing people who guided us along the workshop and taught us about the facilities and the manufacturing processes ... Although I already have an experience of working in a clean room, this experience was really extraordinary due the really high quality process and the endless options of fabrication and research"*.

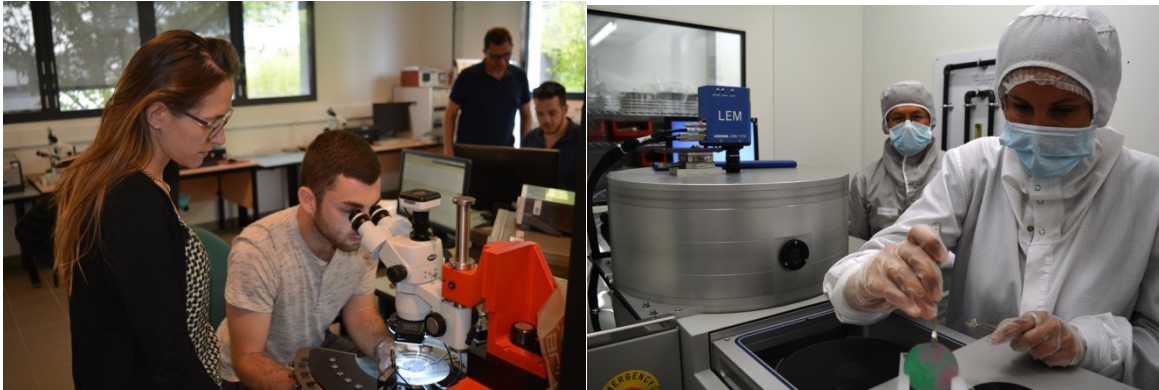


Fig 1. Israeli students on the electrical characterization platform and in the clean room.

At the end of this session, our faculty members unanimously declared themselves very satisfied with the interactions they had with the students. It must be said though that our Israeli colleagues were careful to send only their best elements to Grenoble; this could be felt through the issues that they raised and through their great interest for state-of-the-art equipment at CIME Nanotech. Every student passed these classes with a high grade and left with an attendance certificate that will enable him/her to validate 1.5 ECTS credits in his/her home university.



Fig 2. Israeli students receive their certificate.

Second session

CIME Nanotech hosted a second session dedicated to high school teachers from December 12th to 14th. Eight Israeli high school teachers attended this session (1 group). They followed practicals on electrical characterization, photovoltaics, scan probe microscopy, nanobiotechnology (PCR) and clean room processes.



Fig 3. Israeli teachers practicing photolithography in the clean room under the supervision of Prof. Marceline Bonvalot

In addition to the labworks in our facilities, they met the founders of the Nano@school program. This program, offered to high-schoolers from the area of Grenoble for several years, intends to connect nanotechnology with high school science. This was a unique opportunity for Israeli teachers to discuss nanotechnology teaching issues with their French counterparts.



Fig 4. Learning scan probe microscopy with an haptic interface and electrical circuit characterization

Annexes

Planning for the July session at CIME Nanotech

	CHARACTERIZATION		CLEAN ROOM	
	Thursday 7th	Friday 8th	Monday 11th	Tuesday 12th
8:30				
10:00 - 12:30	WELCOME	G1B G1A free	G1	G1
12:30 - 13:30	LUNCH	LUNCH	LUNCH	LUNCH
13:30 - 17:30	G1A G1B free		G1	G1

	CLEAN ROOM		CHARACTERIZATION / SIMULATION	
	Thursday 7th	Friday 8th	Monday 11th	Tuesday 12th
8:30 AM				
10:00 - 12:30	WELCOME	G2	G2A G2B free	G2 SIMULATION
12:30 - 13:30	LUNCH	LUNCH	LUNCH	LUNCH
2:30 PM				
3:30 PM	G2	G2	G2B	
4:30 PM				
5:30 PM			G2A free	

	Scan Probe Microscopy		Biotechnology	
	Thursday 7th	Friday 8th	Monday 11th	Tuesday 12th
8:30 AM				
10:00 - 12:30	WELCOME	G3B G3A free	G3	G3
12:30 - 13:30	LUNCH	LUNCH	LUNCH	LUNCH
2:30 PM				
3:30 PM		G3A	G3	
4:30 PM				
5:30 PM		G3B free		

Student list and affiliations

EduNano		EduNano				
Univ.	First name	Name	Lab	Contact		
Technion	Heidi	Leonard	Bio	Simcha	4 Bio	
Technion	Sofi	Arshevski	Bio	Simcha		
Technion	Boris	Simakhov	Bio	Simcha		
Technion	Reef	Enoch	Bio	Simcha		
Weizmann	Eran	Mishuk	MOS	Sidney	2 MOS	
Weizmann	Olga	Kranis	MOS	Sidney		
TAU	Yonatan	Vaknin	MOS	Jack	6 MOS	
TAU	Assaf	Peled	MOS	Jack		
TAU	Ronen	Dagan	MOS	Jack		
TAU	Giorgia	Fiaschi	MOS	Jack		
TAU	Richa	Pandey	MOS	Jack		
TAU	Tali	Dotan	MOS	Jack		
Bar Ilan	Tony	Yamin	MOS	Yael	5 MOS	
Bar Ilan	Erez	Zion	MOS	Yael		
Bar Ilan	Efrat	Roth	Bio	Yael	1 Bio	
Bar Ilan	Anat	Yitzhak	MOS	Yael		
Bar Ilan	Tali	Sharabani	MOS	Yael		
Bar Ilan	Yael	Goldfinger	MOS	Yael		
HUJ	Hadas	Han	Bio	Tirza	5 Bio	
HUJ	Dvir	Dror	Bio	Tirza		
HUJ	Itamar	Peled	Bio	Tirza		
HUJ	Shani	Koshrovski	Bio	Tirza		
HUJ	Tal	Stern	Bio	Tirza		
BGU	Nir	Yarza	MOS	Tziona	3 MOS	
BGU	Hadas	Lupa	MOS	Tziona		
BGU	Ofir	Shmolovich	MOS	Tziona		

Planning for the July session at CIME Nanotech

Monday 12

14:00-17:00 Welcome, discussion with the Nano@School team and visit of the CIME Nanotech - Ahmad Bsiesy (CIME) - Eric Martinet (High School Teacher) - Evelyne Excoffon (Académie de Grenoble) - Stéphanie Thollon (CEA)

Tuesday 13

09:00-12:00 Photovoltaic lab - Eric Martinet
 13:30-17:30 Scan Probe Microscopy - Florence Marchi

Wednesday 14

08:30-12:30 Biotechnology (PCR) - Marianne Weidenhaupt
 13:30-17:30 Clean Room practices - Marcelline Bonvallot

Teacher's feedback

- The hospitality was wonderful! 😊
- Hands-on with advanced instrumentation that they only read about
- Excellent teachers in CIME
- Experienced different pedagogy approached (very open inquiry)
- Received ideas how to support students' inquiry
- Their preparation was sufficient (based on Ron's course).

Other pictures of the CIME Nanotech facilities during the labs



Sightseeing tour at "La Bastille"

