# Specialisation Nanotechnologies

## *NANOTECHNOLOGIES*

## NANOTECHNOLOGIES

**Lecturers:** **Virginie MONNIER-VILLAUME**

| Lecturers : 0.0 | TC : 0.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

### Objectives

Nanotechnologies receive each year tremendous investments in research and development. Therefore it is a business sector in strong growth. Nanosciences and nanotechnologies are crossing several scientific fields such as electronics, mechanics, chemistry, optics, biology that manipulate objects at the nanometer size. The objective here is to allow generalist engineers to acquire both technical and scientific knowledges to manage transverse projects and technology transfer. Mixing sciences for the engineer and life sciences, this diploma field proposes high level training in strong interaction with industrial needs in information and communication technologies.

Keywords :

### Programme

NANO3.1 – Memories for the Internet of Things
NANO3.2 – Smart surfaces
NANO3.3 – Photonics guiding
NANO3.4 – Nano-optics

### Learning outcomes

- Model and set up a multidimensional system with interdependent and/or non deterministic components.
- Set hypotheses and evaluate their impacts/their limits.
- Apply knowledges to the resolution of pluridisciplinar problems.
- Analyze in a critical way good practices and progress opportunities.

### Independent study

Objectifs :

Méhodes :

### Core texts

### Assessment

Students must follow the two first courses and make a choice between the two last courses. NANO3.1 : 33% ; NANO3.2 : 33% ;  NANO3.3 : 33% or NANO3.4 : 33%.

## *MÉMOIRES POUR L'INTERNET DES OBJETS*

## MÉMOIRES POUR L?INTERNET DES OBJETS

**Lecturers:** **Virginie MONNIER-VILLAUME, Bertrand VILQUIN, Emmanuelle**

| Lecturers : 0.0 | TC : 0.0 | PW : 16 | Autonomy : 0.0 | Study : 4 | Project : 0.0 | Language : FR

### Objectives

During this course, the students will have to understand the different physical properties that can be found inside a unic ferroelectric material with high potential for innovating applications. They will also elaborate, characterize and use miniaturized and ultrafast digital memories pour the Internet of Things (IoT).
The higher electronic mobility will be one of tomorrow challenges, such as IoT. In the future, the interaction with objects will not be done only using electronic chips or specific commands transmitted by a touch screen, but also by objects themselves.

Keywords : Ferroelectric material, digital memories, internet of things, elaboration, characterization.

### Programme

BE1 (2h): clean room technologies, X-Ray diffraction.
TP1 (4h): nanomaterials deposition in clean room and elaboration of integrated digital memories.
TP2 (2h): structural characterization of ferroelectric digital memories.
TP3 (2h): electrical characterization of ferroelectric digital memories.
TP4 (8h): conception of electrical systems from digital memories.
BE2 (2h): presentation of the results and scientific discussions.

### Learning outcomes

- Understand the challenges and problematics of the Internet of Things.
- Know and use clean room techniques and structural/electrical characterization methods.
- Conceive the architecture of an electrical system.
- Present results in a relevant, rigourous and critical manner, in view of an analysis.

### Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

### Core texts

### Assessment

Final mark = 30% Knowledge + 70% Know-how
Knowledge = 100% written report of the work
Know-how = 40% continuous assessment (active involvement and participation) + 60%

## *SURFACES INTELLIGENTES*

## SURFACES INTELLIGENTES

**Lecturers:** **Magali PHANER GOUTORBE, Emmanuelle LAURENCEAU, Stephane**

| Lecturers : 0.0 | TC : 0.0 | PW : 16 | Autonomy : 0.0 | Study : 4 | Project : 0.0 | Language : FR

### Objectives

In this course, the students will have to elaborate bio-inspired surfaces with specific functionalities (superhydrophobic, super-adhesive,..) thanks to nano/microtexturation. These surfaces will be characterized and analyzed regarding the two specific properties, their wettability and their adhesive potential.

Keywords : Bio-inspired surfaces, surface texturation, wettability, adhesion.

### Programme

TP1 (4h): elaboration of functional surfaces.
TP2 (4h): topographic characterization (nanometric scale)
TP3 (4h): characterization of the wettability of textured surfaces
TP4 (4h): mechanical characterization of the adhesion
BE (2h): presentation of the results and scientific discussions

### Learning outcomes

- Understand the challenges and problematics of functional surfaces.
- Know and use surface elaboration techniques.
- Characterization of surfaces at different scales.
- Set up an experimental protocol.

### Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méhodes : This activity is not concerned with framed autonomy activities outside personal work.

### Core texts

### Assessment

Final mark = 100% Know-how
Know-how = 50% work during practical sessions + 50% oral presentation

## *GUIDAGE PHOTONIQUE*

## GUIDAGE PHOTONIQUE

**Lecturers:** **Emmanuel DROUARD, Pedro ROJO ROMEO, Virginie MONNIER-VILLAUME**

| Lecturers : 0.0 | TC : 0.0 | PW : 18 | Autonomy : 0.0 | Study : 2 | Project : 0.0 | Language : FR

### Objectives

During this course, the students will experiment different aspects of the conception and realization of nanophotonic components in guided optics, on silicon substrate.
After an introduction (about the context of integrated photonics on silicon, challenges), using specific simulation tools, students will conceive the different photonic building blocks necessary to the elaboration of complex systems for routing./guiding light on silicon. They will workin clean room on the different aspects of elaboration (optical and electronic lithography, plasma-assisted etching,...). The elaborated structures will be then characterized by optical and electronic microscopies.

Keywords : Nano-photonics, photonic components, guided optics, lithography, microscopy.

### Programme

BE1 (2h): context, challenges of nanophotonics on silicon, description of tools and methods (simulation, elaboration in clean room)
TP1 (4h): simulation of structures and basic components
TP2 (10h): elaboration of guided optics components in clean room
TP3 (4h): structural characterization (electron microscopy) and optical microscopy (guided optics characterization set-up) of elaborated components

### Learning outcomes

- Understand the challenges and problematics of photonics on silicon.
- Know and use several techniques and equipments used in nanotechnologies.
- First approach of working in clean room environment.
- Conceive and achieve a photonic integrated system.

### Independent study

Objectifs :

Méhodes :

### Core texts

### Assessment

30% for theoretical questions, 30% for involvement and active participation, 40% of methodology and experimental report

## *NANO-OPTIQUES*

## NANO-OPTIQUES

**Lecturers:** **Virginie MONNIER-VILLAUME, Christelle MONAT, Emmanuelle**

| Lecturers : 0.0 | TC : 0.0 | PW : 16 | Autonomy : 2 | Study : 2 | Project : 0.0 | Language : FR

### Objectives

This training will be devoted to the elaboration, of nano-optical devices using with particular diffraction/reflection properties due to their periodic structuration at the wavelength scale. Different kinds of periodic systems will be studied and elaborated using physical routes from thin films (clean room technology) and chemical routes (from colloidal dispersions). Their structural and optical properties will be simulated and characterized.

Keywords : Photonic crystals, thin films, nanostructured periodic systems, opals, simulation, spectroscopy.

### Programme

BE (2h): periodic structures, photonic crystals and synthetic opals.
TP1 (4h): simulation of optical properties of photonic crystals.
TP2 (4h): elaboration of synthetic opales by chemical route.
TP3 (4h): fabrication of Bragg mirrors in the clean room.
TP4 (2h): optical characterization by reflectivity.
TP5 (2h): structural characterization by scanning electron microscopy.
Autonomy (2h).

### Learning outcomes

- Understand the challenges and problematics of photonic crystals and the origin of periodic structures properties.
- Know and use clean room techniques, colloidal chemistry and structural/optical characterizations.
- Simulate optical properties of some photonic structures.

### Independent study

Objectifs : Writing of the report.

Méhodes : Write a full technical report, with correct references.

### Core texts

### Assessment

Final mark = 30% Knowledge + 70% Know-how
Knowledge = 100% answer to theoretical questions
Know-how = 40% continuous assessment (active involvement and participation) + 60 %