PHD PROGRAM AMUTECH

ADVANCED MATERIALS AND NANOTECHNOLOGIES

General information

The AMUtech institute is based on the synergy of the expertises and facilities of nine laboratories of Aix Marseille University involved in the study of advanced materials and nanotechnologies.

The main objective is to use nanoscience and nanotechnology to develop new materials having specific properties at the nano, meso and macroscopic scales, with a particular focus on smart materials and optronics.

The institute aims to bring physicists and chemists together to work on advanced materials that will be used to solve today's major societal challenges.

Objective

The Amutech Institute launches a PhD program devoted to advanced materials and nanotechnology. This PhD program, which is focused on nanomaterials, is designed for a wide audience. It has been built to be easily assimilated by physicists, chemists and enginneers whatever their initial scientific background (no specific prerequisites are needed).

Target audience

The trainings are opened in priority to PhD students but master students enginneers and researchers are welcomed.

Skills

Understanding nanomaterials: students should be able to grasp the basic concepts that give nanomaterials and nanostructured materials their new properties.

Program

The program is divided into two parts.

First part : Nanomaterials, description and properties

The first part is devoted to the fundamentals of nanomaterials. It is itself divided into two sub-parts.

I/ Introduction to nanomaterial properties (7h)

The first sub-part concerns surfaces, interfaces and properties of nano-objects. The main objective is to give, to the students a comprehensive, yet easy-to understand approach of the underlying mechanisms giving birth to specific properties at the nanoscale. In particular, we'll show how, at the nano scale, the properties of materials do noty depend only on their chemistry nature and atomic structure, but also on their size and shape.

Courses

I.1/ Surfaces and interfaces (2h)

Pierre MÜLLER - Wednesday, February 26, 2025, lecture room 1 Étoile Nord (ex EGIM) VP, from 8:30 to 10:30

I.2/ Properties and characteristic lengths (2h):

Pierre MÜLLER - Wednesday, February 26, 2025, lecture room Étoile Nord (ex EGIM) VP, from 10:30 to 12:30

I.3/ Size effects on mechanical, thermodynamic, optical, electronic, magnetic, chemical, and transport properties (3h):

Frédéric LEROY - Monday, March 3, 2025, lecture room 1 Étoile Nord (ex EGIM) VP, from 8:30 to 11:30

II/ Nanostructured materials (8 hours)

The second sub-part is devoted to materials characterized by their nanostructuration. These objects may be macroscopic but with properties modified by their bulk or surface structuration. The case of low dimensionnality materials for which bulk and surface concepts are no more meaningfuill will be adressed.

Courses

II.1/ Porous Materials (2 hours) :

Isabelle Beurroies - Thursday, March 13, 2025, Room 1 Étoile Nord (formerly EGIM) VP, from 10:00 AM to 12:00 PM

II.2/ Metamaterials (2 hours):

Nicolas BONOD - Tuesday, March 25, 2025, Room 1 Étoile Nord (formerly EGIM) VP, from 10:15 AM to 12:15 PM

II.3/ Molecular Assemblies on Surfaces (2 hours):

Thomas LEONI - Wednesday, March 26, 2025, Room 1 Étoile Nord (formerly EGIM) VP, from 1:30 PM to 3:30 PM

II.4/ 2D, 1D, 0D Materials (2 hours):

Thierry ANGOT - Friday, April 4, 2025, Room 1 Étoile Nord (formerly EGIM) VP, from 2:00 PM to 4:00 PM

Second part : nanofabrication and nanoengineering

The second part is devoted to the fabrication of nanomaterials It is itself divided into two sub-parts.

I/ Nanofabrication Methods (8h)

The first subsection focuses on nanofabrication methods. The courses are closely linked to facilities available on the Aix-Marseille campuses of Luminy and St. Jérôme. The methods used by physicists and chemists are described (bottom-up, top-down, soft chemistry, and electrochemical approaches).

Courses

I.1/ Bottom-up methods (MBE, CVD, ALD)

Luc FAVRE - Thursday, November 13, 2025, Room 2 Étoile Nord (ex EGIM) VP, 2:00 p.m. - 4:00 p.m.

I.2/ Top-down methods (lithography, RIE)

Igor OZEROV - Thursday, November 20, 2025, Room 2 Étoile Nord (ex EGIM) VP, 13 :30 a.m. – 15 :30 a.m.

I.3/ Soft chemistry methods (Supramolecular, Sol-gel, Colloids)

Éric BESSON - Wednesday, November 26, 2025, Room 2 Étoile Nord (ex EGIM) VP, 2:00 p.m. - 4:00 p.m.

I.4/ Electrochemical methods (Coatings development and nanostructuring)

Luca PASQUINI - Thursday, November 27, 2025, Room 2 Étoile Nord (ex EGIM) VP, 2:00 p.m. - 4:00 p.m.

II/ Nanoengineering and Integration (7h)

The second subsection is more focused on an introduction to the use of technological platforms closely related to device fabrication. Specific equipment is made available to the students.

Courses

II.1/ Integration of functions into devices

Rémi VAUCHE - Thursday, December 4, 2025, Room 1 Étoile Nord (ex EGIM) VP, 10:00 a.m. - 12:00 p.m.

II.2/ Lithography lab session

Igor OZEROV - Wednesday, December 10, 2025, Planète platform at Luminy, 9:00 a.m. -12:00 p.m.

II.3/ Optical spectroscopy at the nanoscale

Jérôme WENGER - Thursday, December 18, 2025, Room 1 Étoile Nord (ex EGIM) VP, 2:00 p.m. - 4:00 p.m.