MSE-484 **Properties of semiconductors and related nanostructures**

Piazza Valerio

Cursus	Sem.	Type
Materials Science and Engineering	MA2, MA4	Opt.
Quantum Science and Engineering	MA2	Opt.

Language of teaching	English
Credits	5
Session	Summer
Semester	Spring
Exam	During the semester
Workload	150h
Weeks	14
Hours	**5 weekly**
Courses	3 weekly
Exercises	2 weekly
Number of positions	

Summary

This course explains the origin of optical and electrical properties of semiconductors. The course elaborates how they change when the semiconductors are reduced to sizes of few nanometers. The course provides also the basis to use software to calculate the properties of hetero/nanostructures.

Content

We will discuss the relation between the size and the fundamental properties of semiconductor materials. We will as well relate the added functionality related to the low dimensionality with the technological applications.
1. Introduction
2. Basic concepts of bulk semiconductors
3. Fabrication and synthesis techniques
- Top-down versus bottom-up
- Top-down fabrication techniques
- Bottom-up synthesis techniques from the vapor phase (MBE,CVD...)
4. Electronic transport properties of bulk and low dimensional semiconductors
5. Optical properties of bulk and low dimensional semiconductors
6. Simulations of the properties of hetero and nanostructures with Nextnano3

Keywords

semiconductor, absorption, luminiscence, mobility, bandgap engineering, Hall effect,diodes, solar cells, transistors, energy harvesting, energy efficiency

Learning Prerequisites

Required courses

Théorie des matériaux (1 and 2)
Fundamentals of solid state materials (or equivalent)

Recommended courses

Quantum physics

Learning Outcomes

By the end of the course, the student must be able to:

- Propose models which explain the properties of semiconductors

- Apply the gained knowledge for proposing solutions to existing or new devices

Transversal skills

- Write a scientific or technical report.
- Communicate effectively, being understood, including across different languages and cultures.
- Use a work methodology appropriate to the task.
- Collect data.
- Use both general and domain specific IT resources and tools
- Access and evaluate appropriate sources of information.

Teaching methods

Ex cathedra, exercises and simulation laboratory sessions

Expected student activities

Participate in class
Realize exercices
Learn and use simulation software relevant for semiconductor research and industry
Program simple calculations with a programming language (Phython, Mathematica, Matlab...)
Realize a presentation on a topic related to the lecture

Assessment methods

Exercises (3/4) and oral presentation (1/4)

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Ressources en bibliothèque

- The Physics of Semiconductors / Grundmann

Websites

- http://www.nextnano.com/nextnano3/

Moodle Link

- https://go.epfl.ch/MSE-484

Prerequisite for

Semester project, master, PhD thesis