



Course syllabus

Avancerad framställning av nanostrukturer Advanced Processing of Nanostructures

FFFN01, 7,5 credits, A (Second Cycle)

Valid for: 2023/24

Faculty: Faculty of Engineering, LTH

Decided by: PLED F/Pi

Date of Decision: 2023-04-18

General Information

Main field: Nanoscience.

Elective for: F4, F4-nf, MFOT1, MNAV1, N4-nf, N4-hn, N4-m

Language of instruction: The course will be given in English

Aim

The aim of the course is that students, after completing the course, will have acquired in-depth knowledge in the fabrication and characterization of nanoscale devices, intended for use in nanoelectronics as well as in the life sciences. The focus will be on modern material and process techniques currently used in nanotechnology, such as electron beam lithography, scanning electron microscopy, etching, etc. In the laboratory part of the course, the students will have access to a modern cleanroom to make structures and devices using the various process techniques mentioned above.

Working with nanometer-scale structures takes place in a clean and dust-free environment, therefore working methods and safety issues in cleanrooms are important elements of the course.

Learning outcomes

Knowledge and understanding

For a passing grade the student must

- be able to explain and describe different process technologies and how they can be realised in the field of nanotechnology

- be able to describe the structure of a cleanroom
- be able to explain the importance of work methodology in a cleanroom.

Competences and skills

For a passing grade the student must

- be able to independently perform advanced processing in a clean room environment
- be able to design simple devices and write a detailed process flow for their manufacture
- be able to write well-structured technical reports on semiconductor processing
- be able to present results to colleagues

Judgement and approach

For a passing grade the student must

- be able to demonstrate an understanding of the necessity of cleanroom and good cleanroom discipline for the fabrication of components and circuits at the nanoscale in the first place.

Contents

The course consists of two parts:

Lectures begin with basic cleanroom design, classification of cleanroom standards, different sources of particulate pollution, and airflow and air filtration in cleanrooms. Different types of cleanrooms are discussed with a focus on semiconductor and nanotechnology applications. Handling of chemicals and safety aspects of laboratory work will be addressed in the context of the practical exercises in cleanrooms.

In the second and most important part of the lectures, different methods for lithography-based nanofabrication will be discussed in detail. In particular, the lectures will cover electron beam lithography, focused ion beams, nanoimprint and self-assembly in the context of modern nanofabrication methods. The most common steps in the fabrication of nanostructures and devices, such as lift-off, etching and deposition, will also be presented. This knowledge will then be directly applied later in the laboratory part of the course.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)

Assessment: Examination is in the form of a written exam in the middle of the course and through laboratory work and project work during the course. For students who do not pass the regular examination, an additional examination is offered during the scheduled re-examination period. The labs and the course project must be passed in order to successfully complete the course. It is mandatory to attend the first lecture in order to be admitted to the course.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts

Code: 0123. **Name:** Written Exam.

Credits: 3. **Grading scale:** TH. **Assessment:** Passed exam.

Code: 0223. **Name:** Project.

Credits: 4,5. **Grading scale:** UG. **Assessment:** Passed project.

Admission

Admission requirements:

- FFFF10 Processing and Device Technology

The number of participants is limited to: 12

Selection: Completed university credits within the programme. Priority is given to students enrolled on programmes that include the course in their curriculum.

Reading list

- Lecture notes and review articles (to be distributed during the course).
- Zheng Cui: Nanofabrication, Principles, capabilities and limits. Springer, 2017, ISBN: 978-3-319-39359-9, 978-3-319-39361-2 (eBook).
- W. Whyte: Cleanroom Technology, Fundamentals of Design, Testing and Operation. John Wiley and sons, 2001, ISBN: 0 471 86842 6.

Contact and other information

Course coordinator: Docent Ivan Maximov, ivan.maximov@ftf.lth.se

Course homepage: <http://www.ftf.lth.se/education/quick-links-to-course-pages/fffn01-advanced-processing-of-nanostructures/>

Further information: It is mandatory to attend the first lecture in order to be admitted to the course.