Course syllabus

Process- och komponentteknologi
Processing and Device Technology

FFFF11, 7,5 credits, G2 (First Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED N
Date of Decision: 2023-04-17

General Information

Main field: Nanoscience.
Compulsory for: MNAV1, N3
Elective for: E4, F4, F4-nf, F4-fel, MFOT1
Language of instruction: The course will be given in English

Aim

The purpose of this course is to provide fundamental knowledge about fabrication and characterization of semiconductor devices on the nanometer scale. The focus is set on modern materials and processing techniques with nanotechnology as a main theme. Most of the processes are general and are used in silicon-based IC-technology, solar cells, III-V devices (e.g. LEDs/lasers), as well as in electro-mechanical systems.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

- be able to describe fabrication processes that are based on surface patterning, thin film deposition, etching and doping
- be able to explain how such processes can be implemented on the nanometer scale
- be able to explain the connections between choice of material/fabrication process and the function and performance of a device.

Competences and skills
For a passing grade the student must

- be able to carry out basic semiconductor processing in a clean room environment
- be able to analyze a specific device and decide which process steps that are needed for its fabrication
- be able to write a well structured technical report about semiconductor processing.

Judgement and approach
For a passing grade the student must

- demonstrate an ability to reflect on obtained results and an understanding of how a result may be affected by limitations in theoretical models and experimental setups
- demonstrate an ability to discuss challenges related to the industrial evolution in the field and the need for innovations.

Contents

- Growth of semiconductor crystals of different materials and wafer formation - the starting point for semiconductor processing.
- Clean-room technology - how does a clean-room work, and what are its purposes?
- Epitaxy of semiconductors, including heterostructures.
- Lithography - methods for wafer patterning using UV-light and/or electrons.
- Semiconductor/insulator interfaces (MOS structures) and how these can be formed by oxidation and deposition.
- Methods for depositing thin films of insulators and metals.
- Etching: Wet and dry, using acids/bases and plasmas.
- Doping: How small amounts of impurity atoms are introduced in a semiconductor crystal through diffusion or implantation.
- Integrating mechanics and electronics: acceleration meters and other mechanical functions within a chip.
- Process integration - why is CMOS so successful and how do you get all the billions of transistors in a CPU to work?
- How do we fabricate LEDs, solar cells, electronic memories, light sensors and lasers, and how do they operate?

During a series of laboratory sessions, some of the processing steps will be used for fabricating functioning devices. As it is very important that semiconductor processing is done in extremely clean and dust free environment, clean room working methodology will be emphasized.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: Written examination and approved laboratory exercises and report.

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: 0322. **Name:** Processing and Device Technology.
Credits: 5,5. **Grading scale:** TH. **Assessment:** Written examination

Code: 0422. **Name:** Laboratory Exercises and Report.
Credits: 2. **Grading scale:** UG. **Assessment:** Laboratory report in English.

Admission

Assumed prior knowledge: FFFF01 Electronic Materials or FFFF05 Solid State Physics or ESSF20 Physics of Devices.
The number of participants is limited to: 70
Selection: 1. Students for whom the course is compulsory are guaranteed admission 2. Completed university credits within the programme.
The course overlaps following course/s: FFF110, FFFF10

Reading list

- Simon M. Sze, Ming-Kwei Lee: Semiconductor Devices: Physics and Technology, 3rd Edition. Wiley, 2012, ISBN: 978-0470537947. Hard cover version.
- Additional copies.
- Simon M. Sze, Ming-Kwei Lee: Semiconductor Devices: Physics and Technology, 3rd Edition, International student version. John Wiley & Sons, 2012, ISBN: 978-0470873670. Paperback version.

Contact and other information

Course coordinator: Dr. Claes Thelander, claes.thelander@ftf.lth.se
Course homepage: https://www.ftf.lth.se/education/elective_courses/
Further information: One laboratory report must be written in English. It is mandatory to attend the first lecture in order to be admitted to the course.