Thin Film Deposition Technologies for Semiconductor Component Fabrication, 6.0 credits

Tunnfilmsteknologier för tillverkning av halvledarkomponenter, 6.0 hp

Third-cycle education course

6FIFM71

Department of Physics, Chemistry and Biology

Valid from: Second half-year 2025

Approved by **Approved**

Registration number

Entry requirements

Entry requirement for studies on third-cycle education courses

- second-cycle degree,
- 240 credits in required courses, including at least 60 second-cycle credits, or
- acquisition of equivalent knowledge in some other manner

Specific information

This course is intended for Ph D students who in some way work with some sort of thin films deposition or etching, such as CVD, RIE, ALD, ALE, PVD, etc. or just want to broaden their view on thin film deposition and semiconductor manufacturing. The course will cover the major applications of thin film deposition techniques used in high volume production world today such as:

- Chemical Vapor Deposition (CVD)
- Atomic Layer Deposition (ALD)
- Physical Vapor Deposition (PVD)
- Electrochemical Deposition (ECD)
- Spin on Dielectrics (SOD)
- Reactive Ion Etching (RIE)
- Atomic Layer Etching (ALE)

Learning outcomes

By the end of the course the students will be able to:

- Critically reflect on the complexity of modern chip fabrication
- Describe which thinfilm technologies are used to make a chip and why these techniques are used
- Discuss which thin film technologies are best suited for a certain task in the chip production cycle

Contents

The focus is on the use of thin film technologies for manufacturing of:

- 300 mm leading edge wafer manufacturing for Logic, DRAM and 3DNAND chips
- Niche & emerging memory technologies like :
    - spin-transfer torque MRAM (STT-MRAM)
    - Resistive RAM (ReRAM)
    - Ferroelectric FET (FeFET) and RAM (FRAM)
    - Cross-Point memory
- Other wafer-based manufacturing:
    - Photovoltaics
    - MEMS
    - Power Electronics (Si, GaN and SiC)
    - RF, LED/µLED, Optical
- Brief overview of related non-wafer-based manufacturing
    - Flat Panel Display
    - Lithium Battery (EVs, Mobile)
    - Parts and powder coating
    - Medical / Pharma / Healthcare

The course will be based on recent research by and extensie experience of Adjunct Associate Professor Jonas Sundqvist as a consultant to the semiconductor industry and experience from running a start-up in the electronics industry.

Educational methods

The course is given as a series of lectures where active participation is expected.

1. Overview of thin film processing technology in 300 mm leading edge wafer manufacturing for Logic, DRAM and 3DNAND chips
2. Associated processing in semiconductor wafer manufacturing: Lithography, Etch, Clean, CMP and Metrology
3. Semiconductor fabs and wafer processing equipment
4. Thin film materials roadmaps for Logic, DRAM and 3DNAND chips
5. Other wafer-based manufacturing
6. Overview of related non-wafer-based manufacturing

Examination

The course will be examined by an assignment due as a presentation given to the course. Each course participant to pick one of the following topics that is to be presented to the course members and the examiners (Jonas Sundqvist and Henrik Pedersen).
Format: PowerPoint (or equivalent program), approx.10 slides, 15 min

1. Make an assessment of how your own research can be implemented into high volume manufacturing of semiconductor components or associated electronics and technologies as described during the course. The more detailed scope and plan will be made with the examinator.
2. Make a materials and thin film technology roadmap for the next 10 years for any of the applications studied in the course. Identify current state of the art and future challenges and propose solutions:

The examination presentation will be peer reviewed during the ending seminars, in which active participation is mandatory.
Students who fail or are not able to join the ending seminars are offered one re-examination occasion in close connection to the course. After that participation in a coming course examination is offered.

Grading

Two-grade scale

Course literature

All reading material and other course material will be available in a shared OneDrive folder.

General information

The course is planned and carried out according to what is stated in this syllabus. Course evaluation, analysis and suggestions for improvement should be fed back to the Research and PhD studies Committee (FUN) by the course coordinator.