Plasma Physics for Thin Film Processes, 6.0 credits

Plasmafysik för tunnfilmsprocesser, 6.0 hp

Third-cycle education course

6FIFM89

Department of Physics, Chemistry and Biology

Valid from: First half-year 2024

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 mainly intended for Ph.D. students, diploma workers and post docs, who work with plasma-based thin film deposition. The focus is primarily on plasmas in sputter-based techniques, but the knowledge gained on plasma processes is applicable also in other methods.

Learning outcomes

By the end of the course the students will be able to:
Basic characteristics of a (laboratory) plasma

- Plasma parameters and properties
- Gas collisions
- Techniques for generating a plasma

Plasma processes in sputtering

- Magnetron sputtering
- High-power magnetron sputtering (HiPIMS)
- Reactive processes

Fundamentals of plasma diagnostics
Experience with characterization techniques and how to characterize a plasma
Ability to connect the properties of the plasma and plasma-surface interactions with resulting thin film growth
Optimize plasma discharges for thin film deposition
Optimize ionization of the deposition flux
Identify process points and control reactive plasma processes

Contents

The course aims to provide students with a solid understanding of the principles, theories, and applications of plasma physics in thin film technology. The objective is to bridge the gap between fundamental concepts in plasma physics and their practical applications in the deposition and processing of thin films.
Experimental results and simulations of plasmas, based on industrially relevant material systems, will be used to illustrate mechanisms in the plasma process that affect the deposition conditions including nucleation kinetics, column formation, and microstructure evolution.
We will also look at how to characterize plasma discharges to establish general trends on how to optimize any given deposition process. Such process optimization will also allow us to identify what external parameters to adjust for controlling film growth and thereby tune film properties, including hardness, homogeneity, and residual stress.

Educational methods

Educational methods applied in this course are lectures, lab work, and a final seminar

Examination

Course examination comprises a written pre-lecture quiz at the start of each lecture as well as a written home exam at the end of the course. The results of the continuous examination will determine the number of questions on the home exam. The home exam will be peer-reviewed and discussed in a seminar, in which active participation is mandatory.
Students who fail are offered one re-examination occasion in close connection to the course. After that participation in a coming course examination is offered. The re-examination should be equally comprehensive as the ordinary examination.

Grading

Two-grade scale

Course literature

Selected book chapters from Chapman: *Glow Discharge Processes* and Depla: *Magnetrons, reactive gases and sputtering* as well as selected review papers and lecture notes.