Module Description, available in: EN

Advanced thin film technology

General Information

Number of ECTS Credits

3

Module code

TSM_ThinFilm

Valid for academic year

2025-26

Last modification

2021-12-23

Coordinator of the module

Martin Krejci (FHNW, martin.krejci@fhnw.ch)

Explanations regarding the language definitions for each location:

- Instruction is given in the language defined below for each location/each time the module is held.
- Documentation is available in the languages defined below. Where documents are in several languages, the percentage distribution is shown (100% = all the documentation).
- The examination is available 100% in the languages shown for each location/each time it is held.

	Lausanne			Lugano	Zurich		
Instruction					**X** E 100%		
Documentation					**X** E 100%		
Examination					**X** E 100%		

Module Category

TSM Technical scientific module

Profile Recommendations

This module is recommended for the following profiles:

	Zurich
Profile	Pho

Lessons

2 lecture periods and 1 tutorial period per week

Entry level competences

Prerequisites, previous knowledge

- Optics: Basics of wave and geometrical optics;
- Physics basics for engineers
- Analysis and linear algebra on FH bachelor level recommended

The students are required to fill possible gaps by self-study. Students without basic knowledge in optics are requested to complete the EVA module "Fundamentals of Light" prior to the "Advanced Thin Film Technology" TSM module.

Brief course description of module objectives and content

The Technology of thin films is a core element in the design and fabrication of photonic components. The objective of the module "Advanced Thin Film Technology" is the introduction to this important technology and to the applications of thin films in the field of photonics with the focus on optical coatings. This includes the design and fabrication of thin films as well as the characterization of their physical properties.

Aims, content, methods

Learning objectives and competencies to be acquired

The students

- are familiar with the main deposition and structuring methods used in thin film technology. They know the advantages and drawbacks of the different methods and are able to select a suitable method for a given thin film design
- know important microstructural, chemical, mechanical, optical, electrical and thermal properties of thin films and are familiar with the relevant methods used in industry to characterize these properties
- understand the main physical concepts related to the application of thin films in photonics and are able to solve simple problems involving thin layers. They are able to perform calculations and evaluations of optical coating designs.
- know the most important applications of thin layers in passive and active devices

Module content with weighting of different components

There will be several thematic blocks. Although several different types of thin layers will be discussed, the focus will be set on optical coatings:

- Fabrication methods (~3 weeks)
  - A detailed discussion of deposition methods, with the focus on the following deposition method categories: Physical evaporation, Plasma enhanced physical and chemical deposition, liquid phase deposition
  - A rough introduction to structuring methods such as photo-, e-beam and imprint lithography, plasma assisted physical – and chemical dry etching, wet etching, lift-off
- Properties and characterization methods of thin films (~3 weeks)
  - Properties such as morphology, microstructure, optical and electric properties, chemical and mechanical properties
  - Methods such as atomic force microscopy and profilometry, optical an electron microscopy, focused ion beam, x-ray analytical methods, ion beam based methods (SIMS, RBS) as well ellipsometric and spectroscopic methods
- Physics of thin films (~3 weeks)
  - Optical properties:
    - Behavior of radiation in thin layers and at layer interfaces
    - Reflection, transmission and absorption properties of thin layers and and multilayer stacks
  - Material diffusion in thin layers
  - Mechanical behavior and adhesion of thin films
- Simulations of thin films (2 weeks)
  - Numerical simulation of optical properties
- Applications (~3 weeks)
  - Coatings designs for optical components such as lenses, mirrors and filters
  - Planar wave guide structures, gratings or plasmonic structures
  - Thin films in photonic devices

Teaching and learning methods

Will be defined by the lecturers

Literature

Used in lecture:

- Materials Science of Thin Films, 2nd edition, Milton Ohring, Academic Press
- Introduction to Optics, Frank Pedrotti, Pearson

Additional Literature:

- Optical Thin Films and Coatings, Editors: Angela Piegari, François Flory, Elsevier

Assessment

Additional performance assessment during the semester

The module does not contain an additional performance assessment during the semester

Basic principle for exams

As a rule, all standard final exams are conducted in written form. For resit exams, lecturers will communicate the exam format (written/oral) together with the exam schedule.

Standard final exam for a module and written resit exam

Kind of exam

Written exam

Duration of exam

120 minutes

Permissible aids

Aids permitted as specified below:

Permissible electronic aids

- Calculator

Other permissible aids

- Summary and personal formula collection without solved problems (number of pages to be defined by lecturers)

Exception: In case of an electronic Moodle exam, adjustments to the permissible aids may occur. Lecturers will announce the final permissible aids prior to the exam session.

Special case: Resit exam as oral exam

Kind of exam

Oral exam

Duration of exam

30 minutes

Permissible aids

No aids permitted