GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Thin Films: Physics and Technology (E006700)

Course size *(nominal values; actual values may depend on programme)*

Credits 6.0 **Study time 180 h**

Course offerings and teaching methods in academic year 2024-2025

A (semester 1)	English	Gent	seminar lecture practical independent work	
B (semester 1)	Dutch	Gent	lecture	30.0h

Lecturers in academic year 2024-2025

Depla, Diederik	WE04	lecturer-in-charge
Dendooven, Jolien	WE04	co-lecturer

Offered in the following programmes in 2024-2025	**crdts**	**offering**
European Master of Science in Nuclear Fusion and Engineering Physics	6	A
Master of Science in Engineering Physics	6	B
Master of Science in Engineering Physics	6	A

Teaching languages

English, Dutch

Keywords

Thin films, deposition techniques, characterization techniques, industrial applications

Position of the course

The student will gain insight in thin film technology guided by the description of the physical principles dictating each deposition technique. A dedicated discussion of the growth mechanisms of thin films will provide the student insight in the correlation between a deposition technique and the envisaged applications. The student will receive a training, both theoretical and practical, in thin film specific characterization techniques. The importance of thin films and thin film technology for our society will be demonstrated by several applications, presented in collaboration with experts in the field.

Contents

The course comprises five parts:

- Part 1. An introduction on thin film technology and the different application fields with attention for the difference between several deposition techniques.
- Part 2. Growth mechanisms. Nucleation theory is discussed in detail. Both the thermodynamic and the kinetic approach are discussed. The gradual transition from the initial nucleation to a continuous thin film is treated.
- Part 3. Deposition techniques : Physical Vapour Deposition with as examples: thermal evaporation, sputtering and pulsed laser deposition. Chemical Vapour Deposition with focus on atomic layer deposition.
- Part 4. Characterization : The most important ex-situ and in-situ characterization techniques specific for thin film research are covered: Scanning Probe Microscopy, X-ray Photoelectron Spectroscopy, Auger Electron Spectroscopy, ellipsometry, and diffraction techniques. Methods to determine thin film thickness receive special attention.
- Part 5. Applications: The accumulated knowledge from the other four parts of the

course is used to describe and present some important practical applications.

Initial competences

Quantum mechanics I and II, Solid state physics and semiconductors I and II, Electromagnetism I and II

Final competences

1 Describe in a transparent way the physical working principles of the deposition techniques that have been addressed in depth.
2 Explain the growth of thin films, and to identify the most important underlying physical processes.
3 Select deposition techniques for a given application based on their working principles.
4 Design a strategy to study thin film properties based on the acquired knowledge on thin film characterization techniques, their principle of operation, capabilities and limitations
5 Recognize for a number of selected applications the function of the thin film(s).
6 Make essential decisions to develop a thin film for a given application in an economically feasible way.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture, Practical, Independent work

Study material

Type: Syllabus

Name: Course Thin films: physics and technology
Indicative price: Free or paid by faculty
Optional: no
Language : English
Available on Ufora : Yes

Type: Slides

Name: Slides
Indicative price: Free or paid by faculty
Optional: no
Language : English
Available on Ufora : Yes

Type: Software

Name: SRIM/SIMTRA/NASCAM
Indicative price: Free or paid by faculty
Optional: no
Online Available : Yes
Usability and Lifetime within the Course Unit : not applicable
Usability and Lifetime within the Study Programme : one-time
Usability and Lifetime after the Study Programme : occasionally
Additional information: This software packages are free to use. The copyright regulation was negotiated by the lectures with the authors.

Type: Other

Name: Scientific articles
Indicative price: Free or paid by faculty
Optional: no
Language : English
Available on Ufora : Yes

References

The following reference works are available to the students.

- Thin-Film Deposition: Principles and Practice (D. Smith, ISBN: 978-0070585027)
- Materials Science of Thin Films (M. Ohring, ISBN: 9780125249751)
- Handbook of Deposition Technologies for Films and Coatings (P. Martin, ISBN:

9780815520313)
- Glow Discharge Processes: Sputtering and Plasma Etching (B. Chapman ISBN: 978-0-471-07828-9)

Course content-related study coaching

- The seminars give more insight in the topics discussed in the lectures, and permit to apply the theoretical concepts to practical examples.
- The tasks foreseen in the independent work allow the student to individually practice the subjects.
- The practical courses (lab sessions) offer the possibility to get practical insight in theoretical concepts and to get hands-on experience with certain deposition and characterization techniques discussed in the lectures.
- The lectures on applications start with a theoretical explanation about the subject by one of the lecturers for this course, followed by a seminar by a guest lecturer from the work field.
- Teacher is available for individual explanation of course subject matter.

Assessment moments

end-of-term and continuous assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment open-book

Examination methods in case of periodic assessment during the second examination period

Written assessment open-book

Examination methods in case of permanent assessment

Assignment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

Periodic evaluation:
- First examination period: Open book examination
- Second examination period: Open book examination

Non-periodic evaluation
- Solution of excerise regarding sputter deposition by simulations
- Presentation on film thickness measurements by a given technique.

Calculation of the examination mark

Average score calculated based on the outcome per question of the open book exam (13/20).
Results on the non-periodic evaluation (7/20)