GHENT UNIVERSITY

Course Specifications

Valid as from the academic year 2024-2025

Thin Films: Atomic Scale Processing and Analysis (C004512)

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

Credits 3.0 **Study time 90 h**

Course offerings in academic year 2024-2025

A (semester 1)	English	Gent

Lecturers in academic year 2024-2025

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

Offered in the following programmes in 2024-2025	**crdts**	**offering**
Master of Science in Physics and Astronomy	3	A
Exchange Programme in Physics and Astronomy (Master's Level)	3	A

Teaching languages

English

Keywords

Thin films, deposition methods, characterization

Position of the course

In this course, students will gain an understanding of atomic layer deposition and surface modification based on the underlying physical and chemical principles. The various characterization techniques characteristic of thin films will be taught both theoretically and practically. A number of concrete examples are used to demonstrate the importance of thin films for applications.

The content of course C004512 (3.0 credits) overlaps with some of the content of the course Thin Films: Physics and Analysis (C004511, 6.0 credits). Course C004512 aligns with the course Physics of Surfaces and Thin Films (C004449). Students who have taken this course (C004449) in the Bachelor's program may take course C004512 (3.0 credits). Students who have not taken this course (C004449) in the Bachelor's program may take the more extensive course Thin Films: Physics and Analysis (C004511, 6.0 credits).

The content of course C004512 also has significant overlap with the course Thin Films: Physics and Technology (E006700). Therefore, including both courses in the curriculum is not possible.

Contents

• Part 1. An introduction on thin film technology with attention for the different types of deposition techniques and different application fields.
• Part 2. Deposition techniques : Chemical Vapour Deposition with focus on atomic layer deposition.
• Part 3. Stress in thin films : origin and characterization.
• Part 4. Characterization : atomic structure and texture analysis of thin films via diffraction methods (XRD, pole figures), structure information on the nanoscale via grazing incidence small angle X-ray scattering (GISAXS), different methods to determine thin film thickness, both ex-situ and in-situ (ellipsometry, XRR, XRF, QCM).
Finally, the accumulated knowledge from the different parts of the course is used to understand some important practical applications of thin films.

Initial competences

Physics of Surfaces and Thin Films, Materials Physics, Solid State Physics, Atomic and Molecular Physics, Quantum Mechanics

Final competences

1 Describe in a transparent way the physical working principles of the deposition techniques that have been addressed in depth, and select deposition conditions for a given application.
2 Understand the origin of stress in thin films.
3 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.
4 Recognize for a number of selected applications the function of the thin film(s).

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

Extra information on the teaching methods

- The seminars give more insight in the topics discussed in the lectures, and permit to apply the theoretical concepts to practical examples.
- 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.
- Selected applications of thin films may be addressed via a seminar by a guest lecturer from the work field.

Study material

Type: Syllabus

Name: Course Thin Films: Atomic Scale Processing and Analysis
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: Other

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

References

- 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

Individual explanations by instructors, by appointment.

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

Presentation

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:
Give a presentation on a modern deposition- or characterization method or thin film application.

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).