

MSE-450

Electron microscopy: advanced methods

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Cursus	Sem.	Type
Ing.-phys	MA2, MA4	Opt.
Materials Science and Engineering	MA2, MA4	Opt.
Minor in Imaging	E	Opt.
Physicien	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Oral
Workload	90h
Weeks	14
Hours	3 weekly
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

With this course, the student will learn advanced methods in transmission electron microscopy, especially what is the electron optical setup involved in the acquisition, and how to interpret the data. After the course, students will be able to understand and assess TEM encountered in papers.

Content

1. Electron imaging and diffraction contrasts
2. Phase contrast
3. Scanning TEM
4. EDS-, EEL-spectroscopy in TEM.

Exercises and demonstrations concerning these themes.

Learning Prerequisites**Required courses**

- Electron microscopy : introduction
- Basic knowledge of Solid state physics, Crystallography, Crystal defects

Learning Outcomes

By the end of the course, the student must be able to:

- Choose the appropriate TEM technique adapted to their problems
- Recognize The TEM techniques used in a publication
- Interpret TEM images
- Present the TEM results

Teaching methods

Eight weeks of the course are in a mainly "flipped" format, using MOOC-type online video lectures and quizzes. The remaining weeks use a conventional format. We alternate between the two formats over the semester. During the "flipped" weeks, students will participate in interactive demonstrations at the microscopes, where they can see and practice the techniques discussed in the lectures. They will also have interactive Q&A sessions. Demos at the microscopes are also given during the "conventional" weeks, to illustrate various more advanced techniques like aberration-corrected imaging.

Expected student activities

Follow the online teaching material *before* attending the TEM session for the 8 weeks of flipped format.

Assessment methods

Project based evaluation with one individual report + oral evaluation during the exam period.

The written report has to be submitted at last, Sunday of the second week after the end of the teachings. Each student will be individually interviewed based on this report during the exam session.

The grade will be 50% written report 50% oral exam.

Resources

Bibliography

Transmission Electron Microscopy

A Textbook for Materials Science

Williams, David B., **Carter**, C. Barry

Ressources en bibliothèque

- [Egerton. Electron energy-loss spectroscopy in the electron microscope](#)

Moodle Link

- <https://go.epfl.ch/MSE-450>