



*Course syllabus*

# Analytisk mikroskopi och provberedning Analytical Microscopy and Sample Preparation

**FKMN30, 7,5 credits, A (Second Cycle)**

**Valid for:** 2023/24

**Faculty:** Faculty of Engineering, LTH

**Decided by:** PLED M

**Date of Decision:** 2023-04-11

## General Information

**Elective for:** M4, N5-m, MPRR2

**Language of instruction:** The course will be given in English

## Aim

This is a hands-on practical course on using analytical methods in optical and electron microscopy for characterizing the microstructure, local chemistry and crystallographic orientations as well as global texture in metallic materials and minerals. The course is recommended for PhD and final year Masters' project students. Students should understand and acquire best practices on:

- Specimens preparation from bulk samples,
- Using optical- and scanning- electron microscopes (OMs and SEMs),
- Obtaining and interpreting electron backscatter diffraction (EBSD) patterns,
- Obtaining and interpreting energy-dispersive X-ray spectra (EDS)

## Learning outcomes

*Knowledge and understanding*

For a passing grade the student must

- Understand the principles of sample preparation for various methods in microscopy
- Understand the principles of imaging with various methods of microscopy
- Understand the principle of elastic and inelastic electron scattering in solid materials
- Understand the working mode of different detectors in SEM
- Understand advantages and limitations in using OM, SEM, EDS and EBSD

#### *Competences and skills*

For a passing grade the student must

- be able to plan and execute adequate preparation methods for metals and minerals
- be able to apply his/her knowledge on choosing adequate methods for the analysis of metals and minerals, plan and execute analysis independently.
- be able to analyse images and EDS spectra from metals and minerals, both qualitatively and quantitatively
- be able to analyse images and EBSD data from metals and minerals, both qualitatively and quantitatively

#### *Judgement and approach*

For a passing grade the student must

- be able to evaluate accuracy and precision of EDS and EBSD methods
- be able to explain artefacts and sources of errors
- demonstrate the ability to plan and execute the analysis of a specific sample

## Contents

- Specimen preparation from bulk samples for imaging and analysis in OM and SEM
- Principles and functions of different types of microscopes (OM, tungsten- and field-emission filament SEM)
- Overview of solid-state micro analysis methods with focus on Energy dispersive x-ray spectroscopy (EDS)
- Overview of electron diffraction analysis methods with focus on electron backscatter diffraction (EBSD) analysis
- Identification and quantification of elements and phases by morphology, chemical composition and electron diffraction in SEM.

## Examination details

**Grading scale:** TH - (U,3,4,5) - (Fail, Three, Four, Five)

**Assessment:** Practical examination on preparing own specimen and analysis using EDS / EBSD. Written report.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

## Admission

**Assumed prior knowledge:** FKMA01 Materials Engineering, Basic Course and FKMN20 Advanced Materials Technology.

**The number of participants is limited to:** 20

**Selection:** Completed university credits within the programme. Priority is given to students enrolled on programmes that include the course in their curriculum.

## Reading list

- Goldstein, J.I., Newbury, D.E., Michael, J.R., Ritchie, N.W.M., Scott, J.H.J., Joy, D.C.: Scanning Electron Microscopy and X-Ray Microanalysis. Springer-Verlag New York, 2018, ISBN: 978-1-4939-8269-1. Realigns the text with the needs of a diverse audience from researchers and graduate students to SEM operators and technical managers. Emphasizes practical, hands-on operation of the microscope, particularly user selection of the critical operating parameters to achieve meaningful results. Provides step-by-step overviews of SEM, EDS, and EBSD and checklists of critical issues for SEM imaging, EDS x-ray microanalysis, and EBSD crystallographic measurements. Makes extensive use of open source software: NIH ImageJ-FIJI for image processing and NIST DTSA II for quantitative EDS x-ray microanalysis and EDS spectral simulation. Includes case studies to illustrate practical problem solving. Organized into relatively self-contained modules – no need to "read it all" to understand a topic.
- Patrick Echlin: Handbook of Sample Preparation for Scanning Electron Microscopy and X-Ray Microanalysis. 2009, ISBN: 978-0-387-85730-5. This book identifies problems that all specimens present in examining their structure and analysis in the SEM. Describes a series of protocols to ensure that a specimen is properly prepared once the particular problems are identified. Guides the reader through a general approach to the problem before a particular procedure is applied to the requirements of a given sample. Designed both as an introduction for the novice and as a guide for the practicing scanning microscopist.

## Contact and other information

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