Seminars on Analytical Techniques in Materials Science, 3.0 credits

Seminarier om analytiska tekniker inom materialvetenskap, 3.0 hp

Third-cycle education course

6FIFM83

Department of Physics, Chemistry and Biology

Valid from: Second half-year 2024

Approved by **Approved**

Registration number

Entry requirements

Entry requirement for studies on third-cycle education courses

- second-cycle degree,
- 240 credits in required courses, including at least 60 second-cycle credits, or
- acquisition of equivalent knowledge in some other manner

Doctoral studies (also open to senior scientists, etc. depending on availability)

Specific information

Although many of us are familiar with many analytical techniques, such as SEM, XRD, TEM, XPS, *etc.*, but not all of us are aware of their full potential. Many techniques are used as a routine but the user might not always know the true advantage or the drawbacks. Some techniques built at large facility centres, e.g. synchrotron-radiation x-ray scattering and neutron scattering, are unique and important, but we may not know what to study and how to access. We also need to increase the awareness on sample requirements or providing proper information prior the use of the technique in mind. This is something that is fundamental but very often underrated. There are lots of examples where a good work could have been even better with a correct sample preparation or information input.
The purpose of this seminar-based course is to provide a brief introduction focusing on different materials characterization techniques and especially which information that can be extracted in order to increase efficiency in gathering more and better useful information about our materials and to understand how to combine different techniques for complementary information.
A series of technique presentations will give a better insight in how to make the best choice of technique to your studied materials, what kind of information that can be extracted from the measurements, why this technique is a good choice, when another techniques should be considered, and how/where to access these instruments.

Learning outcomes

By the end of the course the students will be able to:

- get knowledge about the fundamentals, advantage, and drawbacks of these analytical techniques
- understand requirements of sample for characterization, including sample handling, information input, sample mounting, sensitivity for contamination
- identify which analytical techniques are suitable to be used for studying their materials
- solve problems of practical issues and most common errors
- summarize and discuss critical issues with specialists

Contents

The seminars consist of presentations given by experts who have been worked these techniques for many years and are in charge of the instruments. The series of presentations is listed as the followings.
1a. Scanning Electron Microscopy (SEM) – Robert Boyd
1b. Cathodoluminescence Spectroscopy in SEM – Galia Pozina

2a. Focused Ion Beam (FIB) – Robert Boyd
2b. Nanoindentation – Lina Rogström

3a. Transmission Electron Microscopy (TEM), General - Justinas Palisaitis
3b. TEM, Imaging - Justinas Palisaitis

4a. TEM, Diffraction - Anna Elsukova
4b. TEM, spectroscopy (EDX/EELS) - Anna Elsukova

5a. Lab source-based X-Ray scattering, powder XRD – Fredrik Eriksoon
5b. Lab source-based X-Ray scattering, HRXRD – Ching-Lien Hsiao

6a. Synchrotron-based X-Ray scattering, in General - Jens Birch
6b. Synchrotron-based X-Ray scattering, Applications – Jens Birch

7a. X-ray Photoelectron Spectroscopy (XPS) - Grzegorz Greczynski
7b. Electrical measurement - Arnaud Le Febvrier

8a. Rutherford Backscattering Spectrometry (RBS) - Daniel Primetzhofer
8b. Elastic Recoil Detection Analysis (ERDA) - Daniel Primetzhofer

9a. Synchrotron X-ray Absorption Spectroscopy, Martin Magnuson
9b. Synchrotron X-ray Emission Spectroscopy, Martin Magnuson

10a. Spectroscopic Ellipsometry - Roger Magnusson
10b. Neutron Scattering – Jens Birch
The outline of presentations includes:

- Fundamentals, advantage, and drawbacks of the technique/the outcomes of the measurement.
- Sample requirements, including sample handling, information input, sample mounting, sensitivity for contamination, etc.
- Representative examples.
- Practical issues/most common errors.
- Access to the technique.
- Advantage of different systems/same technique.
- Information about relevant courses.

Educational methods

Lectures, seminars.

Examination

Part I: 80% correct answers on each test (quiz) after seminar. (10 min)
Student who failed a test have to write a report of the seminar instead. (One A4 page)
Part II: attendance, at least 8 seminars.

Grading

Two-grade scale

Course literature

Lecture notes will be sent by email before the seminar.

General information

The course is planned and carried out according to what is stated in this syllabus. Course evaluation, analysis and suggestions for improvement should be fed back to the Research and PhD studies Committee (FUN) by the course coordinator.