

Syllabus, Optical characterization of thin films, 5 credits

General overview

This PhD course covers the basic theory and experimental methods for the optical characterization of thin films. After completion of the course, the objective is for participants to be able to understand, measure, model, analyze and interpret optical properties and optical processes of thin films, by way of common optical characterization techniques. A particular focus is on topics related to the method of spectroscopic ellipsometry, but also spectrophotometry, photoluminescence and Raman spectroscopy are covered.

As further detailed below, the course includes 8 lectures, 4 seminars, 3 labs and a project.

Next course occasion: April-June 2020.

Registration of interest: carl.hagglund@angstrom.uu.se

Teachers (2018)

Carl Hägglund (course responsible), carl.hagglund@angstrom.uu.se

Tomas Edvinsson, tomas.edvinsson@angstrom.uu.se

Gunnar Niklasson, gunnar.niklasson@angstrom.uu.se

Annica Nilsson, annica.nilsson@angstrom.uu.se

Lecture plan (2018)

Lecture	Topic	Teacher	Time	Room
1.	Course overview Optical properties of materials	Carl Hägglund	13.15-15, April 25	3419
2.	Optical and electronic properties from calculations	Tomas Edvinsson	13.15-15, April 27	3419
3.	Thin film optics	Carl Hägglund	10.15-12, May 2	3419
4.	Effective medium theory	Gunnar Niklasson	13.15-15, May 8	3419
5.	Basics of spectroscopic ellipsometry	Carl Hägglund	10.15-12, May 16	3419
6.	Spectroscopic ellipsometry analysis	Carl Hägglund	13.15-15, May 23	3419
7.	Measurement and analysis by spectrophotometry	Annica Nilsson	10.15-12, May 30	3419
8.	Raman and photoluminescence spectroscopy	Tomas Edvinsson	13.15-15, June 6	3419

Seminar plan (2018)

Seminars will be connected to lectures 1-4. The idea is to have informal discussions about questions and related topics of interest. For each lecture, an article or similar material will be distributed. As part of the examination and in preparation for the seminar, this material is to be studied and 3 questions on its contents must be formulated and emailed to the teacher at least 24 h before the seminar start. The questions will be compiled in anonymous form and used as a starting point for discussion.

Seminar	Topic	Teacher	Time	Room
1.	Optical properties of materials	Carl Hägglund	13.15-15, May 3	3419
2.	Optical and electronic properties from calculations	Carl Hägglund	10.15-12, May 7	3419
3.	Thin film optics	Carl Hägglund	10.15-12, May 15	3419
4.	Effective medium theory	Carl Hägglund	10.15-12, May 22	3419

Labs

Measurements will be performed individually or pairwise.

Lab	Topic	Teacher
1.	Ellipsometry data analysis 1. (computer lab)	Carl
2.	Ellipsometry data analysis 2. (computer lab)	Carl
3.	Spectroscopic ellipsometry measurements	Carl

Project

Sample measurement and analysis by spectroscopic ellipsometry and optionally other techniques discussed in the course. The sample may be something of interest from the research of the participant, if judged sufficiently challenging, or it may be provided in the course.

For the analysis of ellipsometry data, a 30 day student license of the CompleteEase software will be available for installation.

The reports will, after eventual correction and if consent is given by the authors, be made available to the other course participants and ellipsometry users, with the intent to build a knowledge base in support of an active community of ellipsometry users at the Ångström laboratory.

Course requirements

Introductory course in Solid state physics and/or Optics.

Literature

Hand-outs + selected parts of "Optical properties of solids" by Mark Fox (<https://goo.gl/jTL4fG>).

Examination

Active participation in seminars and labs, plus project report.

Web page

<https://mp.uu.se/web/optical-characterization-of-thin-films-2018/>