

## Course title: Electrical characterization for thin-film technology (5 hp)

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### Requirements

MSc education or equivalent in physics, engineering physics, electrical engineering or electronics; Knowledge in semiconductor device physics.

### Aim and Learning Outcomes

This course is aimed at providing the students with the basic knowledge in electrical characterization methods used in thin-film technology and thin-film based device technology. Since the number of electrical characterization methods and instruments for thin-film technology is too large to be covered in a single course like ours, we have identified a set of inter-correlated, complementary methods that are vital for the basic evaluation of thin films and thin-film based devices. The students will have the opportunity to make hands-on exercises using some electrical characterization equipment that is available at the Solid State Electronics (FTE) division, Department of Engineering Sciences, in the Angstrom Laboratory.

After completion of the course the student is expected to be able to

- choose applicable electrical measurement techniques for a particular task concerning thin film technology and thin-film based devices
- understand and operate basic measurement instruments
- make judgment of the accuracy of measurement results based on known parameters of the measurement instruments and statistical analysis of measurement data
- correlate and cross-examine measurement results obtained by using complementary measurement techniques
- recommend further measurement methods if applicable
- recommend or devise the acquisition of new measurement equipment

### Content

8 lectures and 4 lab exercises:

Lectures	Tentative schedule	Location	Lecturer	Subject
L1	TBD	TBD	SLZ/ZZ	Introduction; Resistance; Hall effects
L2	TBD	TBD	UZ	Basics of measurement tools; source-meter, oscilloscope, etc.
L3	TBD	TBD	ZZ	PN junction
L4	TBD	TBD	ZZ	Schottky junction and ohmic contact
L5	TBD	TBD	UZ	LED; PV

L6-7	TBD	TBD	PEH	Transistor (incl. MOS-cap)
L8	TBD	TBD	SLZ/ZZ	Wrap up
L9	TBD	TBD	SLZ/ZZ	Reserved time slot
Final exam	TBD	TBD	ZZ	Written exam

### Lab exercises:

Lab 1: Hall effects (TN)

Lab 2: Contact resistance (ZZ)

Lab 3: Diodes (ZZ) or LED & PV (UZ)

Lab 4: MOS-CAP CV & mobility extraction for FET (ZZ)

SLZ: Shili Zhang; ZZ: Zhen Zhang; UW: Uwe Zimmermann; PEH: Per-Erik Hellström; TN: Tomas Nyberg

### Examination

To obtain the full credits, 5 hp, the participant is required to:

- participate in all lab exercises
- complete and get approved with all lab reports
- pass the final written exam

A completed course is given the marks Pass or Fail.

### Other Directives

- The language of the course is English.
- The reports are written in English.

### Course Literature

- Dieter K. Schroder, "Semiconductor Material and Device Characterization", 3<sup>rd</sup> ed. (John Wiley & Sons, Inc., New York, 2006)
- Handouts