MICRO-566

Large-area electronics: devices and materials

Ballif Christophe, Haug Franz-Josef, Wyrsch Nicolas

Cursus	Sem.	Type
Microtechnics	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

Introduction to the physical concepts involved in the description of optical and electronic transport properties of thin-film semiconductor materials found in many large-area applications (solar cells, displays, imagers, etc) and introduction to the physics of the related devices.

Content

This lecture will start with the general description of thin-film materials which are common in macro-electronic applications. These materials include metal oxides, disordered semiconductors and organic materials. The effect of disorder at the atomic scale on electronic states and electronic transport properties will be discussed, as well as the optical characteristics of such materials in relation to device applications. Then the device physics of various devices based on disordered semiconductors will be presented: first solar cells will be discussed and especially the relation between the material properties (absorption behavior and charge transport) on the cell efficiency. Finally other examples of large-area devices such as photo-detectors, particle sensors and Thin-Film Transistors (for flat panel displays and flat panel imagers) will be presented; the physics of these devices and some fabrication aspects will also been discussed.

Keywords

- thin-films
- ordered and disordered semiconductors
- transparent conductive metal oxides
- organic semiconductors
- optical properties
- electronic properties
- solar cells
- transistors
- particle sensors

Learning Prerequisites

Required courses

Semiconductor physics or Solid State Physics

Learning Outcomes

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

- Distinguish ordered and disordered semiconductors.
- Classify order in a solid on short, medium, and long range.
- Visualize the properties of shallow and deep states in a semiconductor.
- Predict charge transport in semiconductors with band-tails.
- Predict recombination of charge carriers at deep defect states.
- Sketch the working principle of solar cells with p-n and p-i-n junction.
- Sketch the operation of thin film transistors.
- Model the function of thin film transistors in displays, imagers, etc.

Assessment methods

Oral examination

Resources

Bibliography

Arvind Shah, Thin-film silicon solar cells, EPFL Press, 2010.
Robert Street, Hydrogenated amorphous silicon, Cambridge University Press

Ressources en bibliothèque

- Hydrogenated amorphous silicon / Street
- Thin-film silicon solar cells / Shah

Moodle Link

- https://go.epfl.ch/MICRO-566