MICRO-565

Fundamentals & processes for photovoltaic devices

Ballif Christophe

Cursus	Sem.	Type
Electrical and Electronical Engineering	MA2, MA4	Opt.
Energy Science and Technology	MA2, MA4	Obl.
Energy minor	E	Opt.
Microtechnics	MA2, MA4	Opt.
Photonics minor	E	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The objective of this lecture is to give an in-depth understanding of the physics and manufacturing processes of photovoltaic solar cells and related devices (photodetectors, photoconductors). The principle and techniques addressed in this lecture will be useful in a wide range of related fields.

Content

First part : the students will be introduced to the physics of solar cells and photodectectors. They will learn how to describe the main device properties in terms of all the device key parameters (recombination in the bulk and at surfaces, at contacts,...), and will learn how to perform electrical simulation of complex devices. Second part : the most important fabrication process steps will be studied, ranging from multi-wire sawing processing to encapsulation processes, by going through the analyses of steps such as dopant diffusion, material reaction to gettering, dry and wet chemical etching of surfaces, contacting. Finally, the most advanced and innovative devices will be presented, both made out of inorganic crystalline, polycrystalline, and organic materials.

Learning Prerequisites

Important concepts to start the course

A good understanding of basic semiconductor physics is required.

Learning Outcomes

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

- be able to perform efficiently simulations of various devices
- have an in-depth, intuitive understanding of how PV devices work
- understand process manufacturing chain and interlinks
- understand price/cost issue, asses critically PV as a form of sustainable energy.

Teaching methods

- Weekly lectures and exercises session.
- Guided lessons for simulations of photovoltaic devices

Expected student activities

- Attendance at lectures
- Completing and discussing exercises (in class followed by assistants)
- Read and comment scientific papers on photovoltaic devices

Assessment methods

Written exam

Supervision

Others available via email

Resources

Bibliography

Goetzberger, Bernhard Voss, Joachim Knobloch ***Crystalline Silicon Solar Cells*** : A, Wiley 1998
M. Green, ***Solar Cells***, Prentice Hall (1982), Volume 1-2-3
A. Ricaud, ***Photopile solaire, De la physique de la conversion photovoltaïque aux filières, matériaux et procédés,*** Cahiers de Chimie, PPUR, 1997
A. Shah, Editor ***Thin-film Silicon solar cells,*** 1st version 2010, EPFL Press isbn 1420066749

Ressources en bibliothèque

- Solar Cells / Green
- Crystalline Silicon Solar Cell / Knobloch
- Thin-film Silicon solar cell / Shah
- Photopile solaire, De la physique de la conversion photovoltaïque aux filières, matériaux et procédés / Ricaud

Moodle Link

- https://go.epfl.ch/MICRO-565

Prerequisite for

List of subsequent courses for which the successful completion of this course is a prerequisite