Program

#	Date	Contents	Lecturer
1	17.2.	**General introduction** • Course content **Amorphous materials** • Amorphous materials and glasses • Probing near- and far-range order • Microscopic models for hydrogen incorporation in a-Si:H	FH
2	24.2.	**Conductivity, band tails** • Conductivity mechanisms and activation energies • Disorder and tail states • Trap controlled drift conductivity	FH
3	3.3.	**Optical properties** • Dispersion and absorption • Crystals and bands • Band gaps and indirect transitions • Band gaps in disordered materials	FH
4	10.3.	**Defect creation,** • Defects states in a-Si:H • Defect creation, defect equilibrium **Weak bond model** • Bonding orbitals and band states • Thermal equilibrium between weak bonds and a defect • Defect charging and formation enthalpy	FH
5	17.3.	**Processing** • PE-CVD deposition of a-Si:H and related materials • Sputtering/CVD processes	NW
6	24.3.	**Transport and recombination** • Drift and diffusion transport • SRH recombination • Recombination at amphoteric defects	NW
7	31.3	**Materials for photodetectors and photoconductors** • Primary and secondary photoconductivity • Photoconductivity and material quality • Other materials for photodetectors and thin-film solar cells • Xerography	NW
8	7.4.	**Defect kinetics,** • Kinetics of light-induced defect creation and defect annealing (SWE) • Stretched exponentials **Microcrystalline silicon** • Structural properties • Growth model • Conductivity, contact formation	FH
9	14.4.	**Photovoltaics and solar cells** • Basics of photovoltaics • Basics of a p-n junction solar cell • PV cell performance: potential and limits • p-n vs p-i-n junction • Stability issues and constraints on device design • Light-trapping scheme • Tandem devices	FH

	21.4.	**Easter break**	
10	28.4.	**Transparent conducting oxides** • Conductivity vs. transparency • Free carrier effects • Band gap narrowing, optical gap widening	FH
11	5.5.	**Detectors (and related microelectronic) devices** • Vertically integrated devices, system on glass, etc • Position detectors • Particle detectors • Lab on the chip	NW
12	12.5.	**Thin-film transistors (TFT), flat panel displays (FPD) and flat panel imagers (FPI)** • TFT vs FET • TFT operation • TFT configuration and fabrication • Material issue • Application of TFT for FPD, basics of FPD • Flat panel imagers	NW
13	19.5.	**Emerging materials for microelectronics** • Current application issues • Organic materials • Metal oxides **Emerging applications**	NW
14	26.5	**Lab visit PV-Lab Neuchatel** **Q&A**	FH/NW

Oral Exam (subject to change)

25-30 minutes
All students will get a choice of three questions, the candidates can select two of them after one minute of reflection.
A list of formulae to be known by heart will be given to the participants before the end of the semester.

Objectives

- Learn essential aspects of disordered semiconductors, understand the differences to crystalline ones
- Acquire an in-depth, intuitive understanding of how PV and TFT devices work
- Get insight into current issues in Macroelectronics (Materials and Applications)

Some reference books

- Semiconductors:
    - Semiconductor devices, physics and technology, by S. M Sze, Wiley (1985)
- Optics:
    - Optical processes in Semiconductors, by J. I. Pankove, Courier Corp. (2012)
- Thin Films:
    - “Materials science of thin films” by M. Ohring (ed.) Academic Press (2002)
    - ”Thin film deposition” by D. L. Smith (ed.), McGraw Hill (1995)
- Plasma:
    - “Glow Discharge Processes, Sputtering and Plasma Etching” by B. Chapman (ed.), Wiley (1980)
- Amorphous materials:
    - “The physics of amorphous materials” by S.R. Elliott (ed.) Longmann (1983)
    - “Electronic Processes in Non-crystalline Solids” by N. F. Mott and E.A. Davis (eds.) Clarendon Press (1979)
    - “Advances in Amorphous Semiconductors” by J. Singh and K. Shimikawa (eds.) Taylor & Francis (2003)
- Thin film silicon:
    - “Hydrogenated amorphous silicon” by R. Street (1991) ed. Cambridge University Press.
    - Thin-film silicon solar cells, by A. Shah (Ed.), EPFL Press (2010)
- TFT:
    - “Thin-Film Transistors” by C. R. Kagan and P. Andry (Editors), (2003) Decker, New York
- General photovoltaics:
    - “Sonnenergie: Photovoltaik” by A. Goetzberger, Teubner, Stuttgart (1997) (in German)
    - “Crystalline Silicon Solar Cells” by A. Goetzberger, B. Voss, J. Knobloch, Wiley (1998)
    - “Solar Cells, Volumes 1-2-3”, by M. A. Green, Prentice Hall (1982)
    - “Photopile Solaire”, by A. Ricaud, Cahiers de Chimie, PPUR, (1997)
- On-line resource:
    - http://pvcdrom.pveducation.org/

Prerequisites

A good understanding of basic semiconductor physics is required.
Please read SZE, pages 8-100 to get a good background in semiconductors !

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