MSE-478 **Organic semiconductors**

Nüesch Frank

Cursus	Sem.	Type
Materials Science and Engineering	MA2, MA4	Opt.
Photonics		Obl.

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

Summary

This course provides an introduction to organic semiconducting materials starting from fundamental optical and electronic properties of small conjugated molecules and polymers. Electronic and optical solid sate properties and applications in organic and hybrid optoelectronic devices are studied.

Content

1. Conjugated molecules interacting with light (electronic orbitals, optical and electronic properties, photochemical reactions), biological systems
2. Structure and properties of conjugated molecular materials (crystalline materials, polymers, liquid crystals)
3. Applications in electronics and optoelectronics (LCD displays, solar cells, light-emitting diodes, transistors)

Keywords

Organic conjugated molecules, conjugated polymers, molecular orbitals, fluorescence, phosphorescence, energy transfer, electron transport, electronic and optoelectronic devices, hybrid organic-inorganic devices

Learning Prerequisites

Required courses

Basic courses in chemistry, physics or materials science

Recommended courses

Introduction to quantum mechanics. Semiconductor devices.

Important concepts to start the course

Basic knowledge in materials sciences, chemistry or physics

Learning Outcomes

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

- Elaborate a topic in the field of organic optoelectronic devices
- Interpret organic thin film device performance in terms of fundamental processes
- Solve a physical problem in the field of organic semiconductors quantitatively
- Estimate the order of magnitude of physical effects occuring in organic semiconductors
- Differentiate between organic and inorganic semiconductors

- Analyze fundamental processes in organic semiconductors
- Model molecular orbitals and understand how they impact thin film device properties
- Report on a scientific publication

Teaching methods

Black board/Power Point
Lecture notes are handed out
Exercises solved in class
Study of one scientific paper

Expected student activities

Participate actively during the lectures
Exercise work during class

Assessment methods

oral exam

Resources

Bibliography

- Gilbert, J. Baggott, *Essentials of Molecular Photochemistry*, Blackwell Sci. Publ., Oxford, 1991.
- P. W. Atkins, *Physical Chemistry,* 11th edition, Oxford University Press, Oxford, 2018.
- P. W. Atkins, R. S. Friedmann, *Molecular Quantum Mechanics*, Oxford University Press, Oxford, 1997.
- A. Köhler and H. Bässler *Electronic Processes in Organic Semiconductors,* Wiley-VCH, Weinheim, 2015.
- M. Pope, Ch. E. Swenberg, *Electronic Processes in Organic Crystals and Polymers*, Oxford University Press, Oxford, 1999.
- J. Simon, J. J. André, *Molecular Semiconductors*, Springer-Verlag, Berlin, 1985.
- W. Brütting (Hrsg.) *Physics of Organic Semiconductors,* Wiley-VCH, Weinheim, 2005.
- C. Brabec, V. Dyakonov, U. Scherf (Eds.), *Organic Photovoltaics –Materials, Device Physics and Manufacturing Technologies*, Wiley-VCH, Weinheim, 2008.
- W. Clemens, W. Fix, J. Ficker, A. Knobloch, A. Ullmann, *From polymer transistors toward printed electronics*, *J. Materials Research*, Volume 19, Number 7, pp. 1963 – 1973, 2004.
- *Handbook of luminescence, display materials and devices*, ed. By Hari Singh Nalwa, Vol 1, California-American Scientific Publishers, Stevenson Ranch, 2003.
- Müllen, Klaus / Scherf, Ullrich (Eds.) *Organic Light Emitting Devices-Synthesis, Properties and Applications,* Wiley-VCH, Weinheim, 2005.

Ressources en bibliothèque

- Molecular Semiconductors / Simon
- Handbook of luminescence, display materials and devices / Nalwa
- Molecular Quantum Mechanics / Atkins
- Organic Photovoltaics â##Materials, Device Physics and Manufacturing Technologies / Brabec
- Organic Light Emitting Devices-Synthesis, Properties and Applications / Müllen
- Electronic Processes in Organic Crystals and Polymers / Pope
- Electronic Processes in Organic Semiconductors / Köhler
- Physical Chemistry / Atkins
- Essentials of Molecular Photochemistry / Gilbert

Notes/Handbook

Lecture notes are handed out