MSE-486

Organic electronic materials

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Cursus	Sem.	Type
Chimiste	MA2, MA4	Opt.
Ing.-chim.	MA2, MA4	Opt.
Materials Science and Engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	4
Session	Summer
Semester	Spring
Exam	Written
Workload	120h
Weeks	14
Hours	**4 weekly**
Courses	3 weekly
Exercises	1 weekly
Number of positions	

Summary

This course will introduce students to the field of organic electronic materials. The goal of this course is to discuss the origin of electronic properties in organic materials, charge transport mechanisms, chemical synthesis, materials processing, and device fabrication.

Content

1. **Introduction**
   1. Brief History of Organic Electronics
   2. Challenges in Organic Electronics
2. **Intramolecular Electron Delocalization**
   1. From Atomic Orbitals to Molecular Orbitals
   2. Molecular Orbitals in Ï#-Conjugated Systems
3. **Electron Delocalization in Organic Materials**
   1. The Origin of Ï#-Ï# Interactions
   2. Organic crystals of Ï#-Conjugated Molecules
   3. Molecular Orbitals Interaction
4. **Intrinsic and Extrinsic Electronic Perturbations**
   1. Vibronic Coupling
   2. Spin Couplings
   3. Light-Matter Interaction
5. **Charge Formation and Delocalization**
   1. Small Ï#-ConjugatedÂ Molecules
   2. Ï#-Conjugated Polymers
   3. Organic Semiconductor Materials
6. **Transport in Organic Materials**
   1. Electrode Contacts
   2. Transport Regimes
   3. Magnetic Field Effects on Transport
7. **Organic Semiconductor Materials Preparation**
   1. Synthesis of Ï#-Conjugated Molecules
   2. Preparation of Thin Films
   3. Patterning for Devices
8. **Basic Organic Electronic Devices**
   1. Organic Field-Effect Transistors
   2. Organic Photovoltaic Devices
   3. Organic Light-Emitting Diodes
9. **Advanced Topics**
   1. Defects across Length Scales
   2. Organic Sensors
   3. Bioelectronics
   4. Magneto-optoelectronic Devices

5. Spintronics

Keywords

aromaticity, pi-conjugation, conjugated electron systems, electron delocalization, supramolecular interactions, solid state packing, charge carriers, charge transport mechanisms, solitons, polarons, band conduction, organic semiconductors, polymer semiconductors, carbon coupling reactions, thin film preparation, patterning techniques, device fabrication, organic electronic devices, organic field-effect transistors, organic light-emitting diodes, organic solar cells

Learning Prerequisites

Required courses

MSE 211 Organic and macromolecular chemistry (for materials science students, EPFL)
basic organic chemistry courses (students from other disciplines)

Recommended courses

Micro-505 Organic and printed electronics (EPFL)

Important concepts to start the course

notion of the covalent bond
notion of chemical structure and structure drawings
notion of basic physics (atoms, electrons, electromagnetic radiation)

Learning Outcomes

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

- Describe electronic structure of aromatic compounds, electron delocalisation
- Draw molecular orbital diagrams of pi-conjugated systems
- Discriminate charge generation mechanisms
- Apply synthesis methods appropriate for pi-conjugated molecules
- Categorize different classes of organic electronic materials
- Elaborate the preparation of molecules, materials, and devices for organic electronics
- Elaborate functioning of organic solar cells, field-effect transistors, light-emmitting diodes

Transversal skills

- Access and evaluate appropriate sources of information.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Communicate effectively with professionals from other disciplines.

Teaching methods

ex cathedra, slides and blackboard, interactive exercises

Expected student activities

attendance to lectures
active participation in lectures (questions, feedback)
solving the exercise sheets (at home)
complementing course work with literature assignments (at home)
complementing course work with organic and polymer chemistry textbook (at home)

Assessment methods

written examination

Resources

Ressources en bibliothèque

- Organic Chemistry / Clayden
- Electronic Processes in Organic Semiconductors, An Introduction / Köhler
- Organic electronics II : more materials and applications
- Atkins' Physical Chemistry / Atkins

Moodle Link

- https://go.epfl.ch/MSE-486