CH-442

Photochemistry I

Moser Jacques-Edouard

Cursus	Sem.	Type
Chimiste	MA1, MA3	Opt.

Language of teaching	English
Credits	2
Session	Winter
Semester	Fall
Exam	Oral
Workload	60h
Weeks	14
Hours	**2 weekly**
Courses	2 weekly
Number of positions	

Summary

This course presents the theoretical bases of electronic spectroscopy and molecular photophysics. The principles of the reactivity of excited states of molecules and solids under irradiation are detailled. The main classes of industrial and natural photochemical processes are described.

Content

1. Fundamentals
Introduction - Light absorption and reflection - Radiation and molecular orbitals - Photonics of solid materials.
2. Photophysical processes
Excited states deactivation pathways - Kinetics of radiative and nonradiative processes - Excimers and exciplexes - Intermolecular electronic energy transfer - Photosensitization.
3. Photochemical reactions
Photodissociation - Multiphoton processes - Photoinduced electron transfer - Pericyclic concerted reactions.
4. Organic synthetic reactions
Reactions of ethenes and aromatic compounds - Photo-chemical reactions of the carbonyl chromophore - Photo-oxygenation (singlet oxygen, superoxide anion).
5. Polymer and pigments photochemistry
Photopolymerization and cross-linking - Photodegradation and stabilization of polymers and pigments.
6. Natural photochemical processes
Light-induced atmospheric reactions - Natural photosynthesis - Mechanisms of vision.

Keywords

Electronic spectroscopy, Molecular photophysics, Photoinduced electron transfer, Organic photochemistry, Singlet oxygen, Polymer photochemistry, Natural photochemical processes

Learning Prerequisites

Required courses

Physique generale: E#lectromagnetisme (PHYS-201e) - Mathematical methods in chemistry (CH-250) - Quantum chemistry (CH-244) -## Spectroscopy (CH-343)

Recommended courses

Electronic spectroscopy (CH-444)

Important concepts to start the course

Electronic structure of atoms, diatomic and polyatomic molecules. Basic concepts of molecular symmetry and group theory

Learning Outcomes

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

- Formulate the macroscopic and quantum laws of the absorption of light by molecules and solids
- Describe the various deactivation processes of molecular excited states
- Characterize the kinetics of deactivation processes and their role in the photochemical reactivity
- Quote the various types of photochemical reactions
- Explain the basic principles of the thermodynamics and kinetics of photoinduced electron transfer
- Describe the photochemical reactivity of ethenes and carbonyl compounds
- Discuss the properties and reactivity of singlet oxygen and ways to prepare it
- Express the principles of photopolymerization and polymer photodegradation and stabilization
- Represent the mechanisms of natural photochemical processes

Teaching methods

Ex-cathedra lectures with demonstrations in class

Expected student activities

Solving of examplary problems

Assessment methods

Final oral examination

Supervision

Office hours	No
Assistants	No
Forum	No
Others	The teacher is available to answer questions asked by email to je.moser@epfl.ch. If required, Zoom meetings can be organized during the semester term and the period preceeding the exam.

Resources

Ressources en bibliothèque

- Principles and applications of photochemistry / Wardle
- Photophysique et photochimie : des fondements aux applications / Delaire

Notes/Handbook

All copies of the slides are availbale in pdf format on the course's web pages

Websites

- https://gdp.epfl.ch/pc1