UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Photochemistry

2627-2-F5402Q023

Aims

The course aims to provide students with an overview of the processes that involve the interaction between light and chemical systems.

Knowledge and understanding skills. At the end of the course the student knows and understands the aspects of the interaction between the molecules and the electromagnetic radiation, the characteristics of electronic excited states and their processes of decay. He also knows the instruments used for the study of species and photochemical processes and applies the knowledge of photochemically active natural and artificial systems.

Knowledge and understanding skills applied. At the end of the course the student

- is able to place in the theoretical framework represented by Fermi's golden rule the various processes of decay of the electronic excited states discussed in various fields of application;
- has acquired the familiarity of spectroscopic and chemical synthesis techniques of photochemical relevance.

Autonomy of judgment.

At the end of the course the student is able to assess the process of active decay in a given photochemical phenomenon with contextual development of a broad vision concerning the approprate methodology of investigation.

Communication skills.

Ability to communicate in oral form and ability to sustain a contradictory on the basis of judgment abilities developed autonomously on photochemical issues.

Ability to learn. The student will be able to apply the acquired knowledge to contexts different from those presented during the course, and to understand the topics covered in the scientific literature concerning the

phenomena of decay of excited molecular states.

Contents

The course starts with a discussion of the basic principles of photochemistry such as the evolution and decay processes of the electronic excited states and photoreactivity. These contents are essential for the understanding of photochemical and photophysical phenomenon. Subsequently, we present some applications in the field of photobiology, photocatalysis and luminescence.

Detailed program

Electronic excited states and their description within the molecular orbitals model. Jablonski diagram, the time scale and probability within the Fermi golden rule of the electronic excited state decay. Concept of excited state lifetime and of quantum yield. Energy transfer phenomena (Förster and Dexter mechanisms). Photoinduced Electron transfer and its description within Marcus theory. Redox processes involving electronic excited states and Rehn-Weller equation. Antenna systems and photosensitizers. Organic and inorganic photochemical reactivity. Water splitting: from natural to synthetic systems. Photocatalysis and photocatalytic applications: light-assisted H2 production and CO2 photo-reduction. Surface-photosensitizers systems: the case of TiO2-sensitizers system. Applications in photo- and chemiluminescence.

Prerequisites

Basic knowledge of quantum mechanics (Hamiltonian molecular operator, Schroedinger equation for atomic and molecular systems, variational method and calculation of the expectation values ??of an operator, Born-Oppenheimer approximation)

Teaching form

24 two-hour lectures, in person, Delivered Didactics

Textbook and teaching resource

Textbooks:
"Photochemistry and Photophysics. Concepts, Research, Applications" Vincenzo Balzani, Paola Ceroni and Alberto Juris. Wiley 2014
“Principles and Applications of Photochemistry”, Brian Wardle, Wiley 2009;
“Principles of Modern Molecular Photochemistry: an introduction” Nicholas J. Turro, University Science Book (2008)

Semester

1st semester

Assessment method

Individual oral interview during which the level of knowledge acquired is verified in terms of autonomy of analysis and judgment, in terms of ability to critically evaluate the contents developed during the teaching, as well as in terms of linking abilities with the contents of other courses. Evaluation: 18-30 / 30 with possible praise.

Office hours

On appointment (by email)

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY