TITOLO DEL CORSO
Lights on green chemistry

Lingua insegnamento
English

Contenuto del corso (abstract)
If light was a chemical, there won't be competition for the most sustainable reactant: its cost, cleanness, and availability make it the perfect ingredient for every process. Once the technologies to exploit it were proven, it has started growing in the field of green chemistry rooting in many applications.
Focusing on the green chemistry requirements for energy efficiency, circular economy of materials, and catalytic transformations, in this course we will explore technologies that answer such requirements making use of light's energy like photovoltaics, artificial photosynthesis, and photocatalysis. Once analyzed the technologies working principles, the devices' architecture, and the parameters to evaluate it, we will focus on the role of organic chemistry behind their key components. In fact, when light exploitation is desired, we may find organic compounds playing their key role as photosensitizers. For each technology, we will list the properties expected from organic sensitizers, explore the working mechanisms from a molecular perspective, and finally focus on the most accounted structure-activity relations reported in the literature over the years. The desired outcome would be to give a general knowledge of the potentialities of the class of organic compounds defined as photosensitizers, and to pave some strategies and directions for the development of new compounds that could play an active role in green chemistry, acting as key components in light exploiting technologies.

Programma del corso
Lesson#1
Introduction to the course. Green Chemistry and sustainable technologies exploiting light.
Energy production: photovoltaic. Classification of photovoltaic technologies.
LSC: working principle, device architecture, parameters to evaluate the devices. Luminophores: the role of, required physical and chemical properties, types of luminophores, common features in structural design of organic luminophores. Literature examples.
Lesson#2
DSSC: working principle, device composition, parameters to evaluate the devices. Photosensitizers: the role of the dye, required physical and chemical properties, classes of dyes. Modular design: common features in structural design, planarity of the dye, anchoring and stability, optical transparency. Literature examples.
Lesson#3
Fuels production: solar fuels.
Artificial photosynthesis: photocatalytic water splitting, working principle, two main device architectures, DSPEC, parameters to evaluate the devices. Catalyst-sensitizers relationship, energy transfer mechanisms, I2M and WNA mechanisms, physical and chemical properties of catalyst and sensitizer, common features in structural design. H_2 production: sacrificial electron donors, dye-sensitized photocatalytic hydrogen production, chelating dyes, hydrophilicity effect. Literature examples.
Lesson#4
Organic synthesis: heterogeneous photocatalysis.
Dye-sensitized semiconductors: mechanisms at play, strategies of sensitization. The need for photocatalysts, excitons and energy transfer, devices and light sources, reaction parameters. Photoredox catalysis on semiconductors, common structures in dyes and LMCT sensitizers, redox potentials, the superoxide anion. Literature examples.

Prerequisiti
Corsi vincolanti: nessuno
Corsi raccomandati: nessuno

Totale: 8h

Periodo: June – September 2022

Metodi Didattici

4 Lezioni registrate e rese disponibili entro Giugno 2022

4 Recorded lectures available from June 2022

Modalità di verifica apprendimento (final evaluation)

Elaborazione di un brevissimo progetto di massimo due pagine riportante massimo tre composti organici dalla struttura innovativa, che potrebbero essere impiegati in almeno una delle tecnologie trattate del corso. Evidenziare quali sarebbero le proprietà previste per i composti elaborati supportando le ipotesi con alcune fonti bibliografiche. Argomentare la scelta delle strutture in relazione alle proprietà e all'applicazione ipotizzata. Illustrare brevemente il proprio progetto con massimo cinque slides durante un seminario online con tutta la classe.

Write a short project of maximum two pages reporting the invention of maximum tree organic compounds with unreported structure, that could be exploited in at least one of the theologies presented in the course. Highlighting what properties are foreseen for the compounds, supporting the ideas with few connected literature examples. Explain how the expected properties will make the compounds suitable for the selected technology. Present the project to the class with maximum five slides during an online meeting.